Submerged Cultural Resources Survey

POINT REYES NATIONAL SEASHORE
and
POINT REYES - FARALLON ISLANDS
NATIONAL MARINE SANCTUARY

Phase I - Reconaissance

Sessions 1 and 2
1982

[redacted]

[redacted]

LARRY MURPHY, Editor
SUBMERGED CULTURAL RESOURCES UNIT
NATIONAL PARK SERVICE

POINT REYES NATIONAL SEASHORE AND
POINT REYES–FARALLON ISLANDS NATIONAL MARINE SANCTUARY

SUBMERGED CULTURAL RESOURCES INVENTORY

Shipwreck Survey
Point Reyes National Seashore
and Point Reyes—Farallon Islands National Marine Sanctuary

Phase I — Reconnaissance
Sessions 1 and 2
1982

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Southwest Cultural Resources Center
and Western Regional Office
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SUBMERGED CULTURAL RESOURCES UNIT
REPORT AND PUBLICATION SERIES

The Submerged Cultural Resources Unit is a part of the Southwest Cultural Resources Center, Southwest Regional Office in Santa Fe, New Mexico. It was established as a unit in 1980 to conduct research on submerged cultural resources throughout the National Park System with an emphasis on historic shipwrecks. One of the unit's primary responsibilities is to disseminate the results of research to National Park Service managers as well as the professional community in a form that meets resource management needs and adds to our understanding of the resource base. The following publication and report series has been initiated in order to fulfill this responsibility. The report "types" listed below represent the sequential stages of research activity that the unit is conducting or initiating in each park with a submerged cultural resources base. The reports are designed to be cumulative so that, in the ideal case, each marine or freshwater park would eventually have a "maritime archeology" publication which would have been preceded in most cases by an assessment, survey and inventory. This would put the parks in compliance with any reasonable professional and legal requirement to protect and interpret the underwater cultural resources under their custodianship.

Submerged Cultural Resources Assessment

First line document that consists of a brief literature search, an overview of the maritime history and the known or potential underwater sites in the park, and preliminary recommendations for long-term management. Designed to have application to GMP/DCP's and to become a source document for a park's Submerged Cultural Resources Management Plan.

Submerged Cultural Resources Survey

Comprehensive examination of blocks of park lands for the purpose of locating and identifying as much of the submerged cultural resources base as possible. A comprehensive literature search would most likely be a part of the Phase I report but, in some cases, may be postponed until Phase II.

Phase I - Reconnaissance of target areas with remote sensing and visual survey techniques to establish location of any archeological sites or anomalous features that may suggest the presence of archeological sites.

Phase II - Evaluation of archeological sites or anomalous features derived from remote sensing instruments to confirm their nature, and if possible, their significance. This may involve exploratory removal of overburden.

Submerged Cultural Resources Inventory

A document that discusses, in detail, all known underwater archeological sites in a given park. This may involve test excavations. The intended audience is managerial and professional, not the general public.

Site Report

Exhaustive documentation of one archeological site which may involve a partial or complete site excavation. The intended audience is primarily professional and incidentally managerial. Although the document may be useful to a park's interpretive specialists because of its information content, it would probably not be suitable for general distribution to park visitors.

Maritime Archeology Series

This is a series of publications on specific parks designed for appeal to a general audience including subject matter specialists, managers and the public at large, e.g., The Maritime Archeology of Isle Royale National Park. It fulfills an educational and interpretive function but meets professional standards in accuracy and substance.

Special Report Series

These may be in published or photocopy format. Included are special commentaries, papers on methodological or technical issues pertinent to underwater archeology, or any miscellaneous report that does not appropriately fit into one of the other categories.

Daniel J. Lenihan

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ACKNOWLEDGMENTS

The shipwreck survey of portions of Point Reyes National Seashore and associated National Marine Sanctuary areas resulted from a research proposal developed by Park Superintendent John Sansing and his staff.

Roger Kelly coordinated efforts between the park, the Western Regional Office and the Submerged Cultural Resource Unit, the Servicewide underwater archeological team. Dave Pugh was responsible for park logistical operations and deftly resolved the many problems as they arose. Park Ranger Russ Lesko was the initial contact for the first visit to Point Reyes of Unit archeologists and continued to contribute enthusiastic support throughout the survey.

Pete Gogan, coordinator of the Point Reyes-Farallon Islands National Marine Sanctuary, provided onsite interface between the Sanctuary, park and the National Oceanographic and Atmospheric Administration Office of Ocean and Coastal Resource Management.

The State of California provided the services of Archeologist John Foster during the field work.

This project was funded by the National Oceanographic and Atmospheric Administration Marine Sanctuary Program and the National Park Service. The U.S. Coast Guard provided a 33-foot diesel survey boat and a three-man crew for two weeks, greatly augmenting the cost-effectiveness of the operation. The Motorola Corporation made very significant contributions to the project, including instruments, personnel and training time. The U.S. Geological Survey Office of Marine Geology contributed the time of some of their personnel as well as equipment for field operations.

Additional assistance was provided by Texas A&M Civil Engineering Department and CCM Leasing of California, from whom equipment and operators were leased to the project at non-profit rates. EG&G Geometrics Instrument Division provided on-site technical assistance.

The cooperative interplay between Federal and state agencies and the private sector has produced the most comprehensive underwater archeological survey to date on the Pacific coast.

Participants

The successful completion of the two sessions of this Phase I survey was the result of the cooperative effort of many competent people. The following were involved in the field work:

Session 1

Project Coordinator:

Roger Kelly, Regional Archeologist, Western Region

Southwest Cultural Resources Center:

Daniel Lenihan, Chief, Submerged Cultural Resources Unit (SCRU)
Larry Murphy, Archeologist, SCRU, Positioning System & Instrument Operation
Ron Ice, Archeologist, Division of Anthropology
Jerry Livingston, Scientific Illustrator, Division of Cultural Resources

Seashore Coordinator:

David Pugh, Chief, Division of Interpretation

Media Relations:

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William Thomas, Public Information Office

Artifact Conservator:

Brigid Sullivan, Western Archeological and Conservation Center

Motorola Mini Ranger Satellite Positioning System Operation:

Bill Ewin

Positioning System Contractor:

Ervan G. Garrison, Texas A&M, Department of Civil Engineering
James Baker, Instrument Operation
James Tribble, Instrument Operation

Survey Boat Operation:

United States Coast Guard, Vessel 33001, San Francisco Base
Bob Burns, Bosun's mate 3
Brian Keith, Mechanics Mate 3
Scott Hellige, SM 2

Point Reyes National Seashore:

Leroy Brock, Chief Ranger
Steve Wolfe, Supervisory Ranger
Russ Lesko, Ranger
Charles Yung, Ranger
Diana Skiles, Assistant Chief of Interpretation

Assisting Divers:

David Buller, Volunteer-in-Parks (VIP), Pinole, California
Noreen Buller, VIP, Pinole, California
Barry Leff, EG&G Geometrics, Sunnyvale, California
Martin Mayer, Golden Gate National Recreation Area (NRA)
James Delgado, Golden Gate NRA

Historical Information:

James Delgado, Park Historian, Golden Gate NRA
David Buller, VIP

Photography:

Diana Skiles, Park Historian, Point Reyes National Seashore
Richard Frear, Regional Photographer, Golden Gate NRA
James Huddleston, Video Documentation, Western Regional Office

Equipment Assistance:

Martin Mayer, Cultural Resource Specialist, Golden Gate NRA
Robert Bennett, VIP, San Rafael, California

Coordination with Others:

Project Tektite, Inc., led by Dr. Hal Ross, provided flagged wooden buoys, use of a battery charger, outboard motor, and inflatable boat for the project. Robert Reed and a fellow Project Tektite volunteer visited the project survey vessel during one day's operation.

Session 2

Project Coordinator:

Roger Kelly, Regional Archeologist, Western Region

Southwest Cultural Resources Center:

Daniel Lenihan, Chief, Submerged Cultural Resources Unit
Larry Murphy, Archeologist, SCRU, Positioning System and Instrument Operation
Toni Carrell, Archeologist, SCRU

Seashore Coordinator:

David Pugh, Chief, Interpretation, Point Reyes National Seashore

Media Relations:

David Pugh, Chief, Interpretation, Point Reyes National Seashore

Side Scan Sonar Systems Contractor:

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Carl Moller, CCM Leasing, Escondido, California

Survey Boat Operation:

Bob Lundberg, Captain of the Nick

Dive Boat Operator:

John Foster, Archeologist, California Parks
David Buller, VIP

Point Reyes National Seashore:

Charles Yung, Ranger
Diana Skiles, Park Historian, Point Reyes National Seashore

Equipment Assistance:

Motorola Inc., Chris Boschen, Programs Development Manager, provided the use of the Motorola Mini-Ranger III
United States Geological Survey, Office of Marine Geologist, provided use of equipment and personnel
Scott Briggs, Geologist
David Ruben, Geologist
Dave Hogg, Technician, Instrument Operation

Photography:

James Huddleton, Video Documentation, Western Regional Office

Assisting Divers:

James Delgado, Golden Gate NRA
David Buller, VIP
Noreene Buller, VIP
John Foster, Archeologist, California Parks

Vessel Instrument Assistance:

Martin Mayer, Golden Gate NRA
Robert Bennett, VIP

Coordination with Others:

Peter Gogan, Marine Sanctuary Manager, maintained contact with the research team and spent a day aboard the survey boat. John Foster officially represented the state of California's Department of Parks and Recreation and State Lands Commission during the second session.

Documentation of Exposed Ship Structures (Winter 1982):

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EXECUTIVE SUMMARY

This volume reports the results of a shipwreck survey made possible through the cooperative efforts of the National Park Service and the National Oceanic and Atmospheric Administration. The survey was conducted on submerged lands within the jurisdiction of both agencies and was designed and executed to provide baseline information on potentially significant historical shipwrecks sites. It is intended as an aid for managers in making decisions regarding the monitoring, protection and interpretation of submerged resources in these areas.

Point Reyes and Drakes Bay have been important in the early historical development of the San Francisco region and consequently been the location of numerous shipwrecks. The earliest wreck dates from the period of colonial exploration when the Spanish Manila Galleon San Agustin was sunk in Drakes Bay in 1595. There are at least 72 other marine disasters recorded during the period 1840 to 1940, resulting in at least 30 wrecks in the area, with 15 in Drakes Bay or on the Point Reyes headlands. The history section of the report discusses each of the wrecked vessels and has been provided to assist site evaluation and visitor interpretation. Increasing interest and heavier diver visitation have made the necessity of developing a better understanding of these cultural resources a priority.

Studies were conducted during two sessions in 1982, August 23 to September 5 and October 4 to 14. This reconnaissance survey relied on remote sensing instruments: the magnetometer which detects changes in the earth's magnetic field and used to locate ferrous remains; the side scan sonar which produces a photographic-like image of material above the sea floor; and the sub-bottom profiler which produces an indication of the sediment above the rock substrate. The magnetometer was used around the margins of Drakes Bay for buried wreck detection; the sonar in the bay and along the headlands and Pacific coast areas to detect vessel structure above the bottom; and the sub-bottom was used to determine the nature of the subsurface geology and depth of overburden which would have to be removed for testing target areas in Drakes Bay.

A total of 6.5 square kilometers (2.5 square miles) of magnetometer coverage was completed and mapped giving 684 anomalous reading. These readings were analyzed and 49 clusters of anomalies were indicated for priority test excavation. Twenty-six square kilometers (10 square miles) of side scan sonar coverage were completed in Drakes Bay and 7.7 kilometers were surveyed along the headlands and Point Reyes Beach. Forty-eight kilometers (30 linear miles) of sub-bottom profiler survey was done to provide an accurate picture of the bay geology. It was determined that the depth of overburden in the survey area ranges from a few centimeters to over 7 meters deep.

The results of the survey are primarily the anomalous magnetic readings and their location. These readings indicate the existence of ferrous material of unknown age and origin. Furthur fieldwork involving test excavations and physical examination will have to be conducted before shipwreck sites can be identified and their significance determined. Three vessels were located during the survey and investigated by divers as a part of the ongoing program of archeological site evaluation in the sanctuary and park. Two of these vessels were located on the southern coastal margin of the headlands and identified as <u>Hartwood</u> (1916-1929), a steam schooner and <u>Munleon</u> (1919-1931) a screw steamer built on the Great Lakes. Both of these vessels have intact structure visible and could be considered as sport diver attractions. The third vessel, steam schooner <u>Pomo</u> (1903-1914), is located offshore of Limantour Spit in Drakes Bay. There is no structure above the bottom sediment, but the triple-expansion steam engine is visible in the shallows at low tide.

This survey, the largest of its kind on the west coast, was participated in by the U.S. Coast Guard and private sector volunteers and corporations which enabled its execution for a total expenditure of $11,838 beyond normally programmed expenses and salary. The National Oceanic and Atmospheric Administration made $12,000 available for the survey.

I. INTRODUCTION

Research Objectives

The primary objective of the 1982 submerged cultural resources survey conducted within Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary was to detect shipwreck sites in preselected portions of the area known as Drakes Bay. A secondary objective was to locate the remains of a particular Spanish vessel, San Agustin, which was engaged in the Manila-Acapulco trade. Historical documents indicate the ship wrecked near Drakes Estero in 1595. The objectives of this underwater survey did not include locating other submerged sites (i.e., former human occupation or other land-based human activity sites) because the location and identification of shipwrecks in the Drakes Bay vicinity are currently more important for National Park Service (NPS) and National Oceanic and Atmospheric Administration (NOAA) management needs.

The completion of this survey will enable the National Park Service Administration and NOAA to partially meet requirements in respective agency policy documents and Section 206 of Public Law 96-515 regarding the inventory and recording of cultural resources within Federal lands by government agencies.

The investigation was conducted so that waters under NPS jurisdiction could be saturation-covered for shipwreck remains in order to determine not only where wrecks probably are, but where they definitely are not. These two considerations can sometimes be equally important for management needs. The overall aim, therefore, was a state-of-the-art submerged cultural resources inventory of large portions of the Seashore and associated National Marine Sanctuary submerged lands.

Also of basic importance in the research approach is the documentation that a 16th-century vessel, San Agustin lost during the 1595 Cermeno Expedition, is located in or near the survey area. The location and identification of this vessel would be of particular significance to both researchers and resource management personnel. Shipwrecks represent unique historical events, and they are particularly important not only to historians, but to social scientists. Our present-day understanding of pre-19th-century ship construction, maritime material culture, and shipboard interaction is extremely poor. Therefore, test excavations of a 16th-century merchant ship, especially a ship that was involved in long distance trade with Manila, would produce invaluable data.

Most large vessels carry a full complement of material culture that includes all the things that are necessary for a shipboard community's existence during long periods at sea. In many cases, the cargo is a prime indicator of the trade and resource exploitation networks in the part of the world in which the vessel was wrecked. Shipwrecks are also repositories for period artifacts, which are often

found in a better state of preservation than when they are found on land. Analysis and interpretation of this material record can tell us much about prior human lifeways that is not available in historical documents, since details concerning the mundane aspects of day to day shipboard living are rarely provided.

Shipwrecks also have special value as chronological indicators. For instance, knowing from historical documents that a particular ship went down in 1782 (assuming it has been positively identified by archeological and historical research), we know that any artifact or facet of design and construction extant on the site was in existence before the moment of sinking in 1782 (referred to as terminus ante quem). In a discipline plagued by "gray areas," as is archeology, such precise data are extremely important. Also, if materials that can definitely be associated with the wreck appear in a stratified land deposit, such as an Indian midden, they may yield positive dates for that particular stratum. Professor Robert Heizer, University of California, Berkeley, who conducted research in the middens around Limantour Spit well before the development of radiocarbon dating and other "absolute" dating techniques were available, was clearly interested in the Drake/Cermeno controversy for this reason.

Although historians and the archeological community were integral to the research design of the current project, the overall objectives were managerial and most directly influenced the specifics of the strategy employed. From the perspective of resource management, it is difficult to intelligently protect and conserve the cultural resources of the National Park System and National Marine Sanctuaries if their locations or their very existence are unknown. Therefore, the purpose of the Point Reyes survey was to gather and present archeological data in a format that would enable park and marine sanctuary managers to better understand the nature and extent of the shipwreck remains in their areas. Managers who know the distribution and accessibility of shipwreck sites can monitor and protect them. A knowledge of which areas are culturally "sterile" (free of submerged cultural resources) can be used as an important planning tool, enabling managers to permit activities such as dredging, depositing spoils, and laying mooring anchors. The survey information can also contribute to the development of a predictive model of natural impacts to archeological sites.

It can be seen from the design of this report that the intent of the investigation is to provide a professional document that can be useful to a park manager who may have little or no technical marine or scientific research background. Depending on level of interest, the reader may move from the Executive Summary to the Survey Results and on to the Management Recommendations without getting wet feet from the swamp of detailed information and methodological concerns, which are the mainstay of most scientific enterprises.

A brief glossary has been included to aid those not familiar with some of the terminology used in the report.

In addition to using the survey data for future protection and compliance needs, managers can use the historical background research presented in this report for developing an enriched interpretive program for both the park and the marine sanctuary at Point Reyes. An interpretive program for seashore parks or other coastal preserves cannot be considered comprehensive if it does not include information about its submerged resources.

Organizationally, the project's objectives were carried out with the cooperation of people from several National Park Service offices as well as with the assistance of several other agencies and organizations. The initial proposal was written by the staff of Point Reyes National Seashore after consultation with the Western Regional Archeologist and the Chief of the Service's Submerged Cultural Resources Unit. The Western Regional Archeologist then became the project coordinator and served as liaison for relations between the region, park, Marine Sanctuary, and the Submerged Cultural Resources Unit, which was directly in charge of the research operations.

The best indicator of the cooperative nature of this project, which relied heavily on interagency assistance and contributions of time and funds from the private sector, is the multiple authorship of this report. In addition to the efforts of the staff from the Submerged Cultural Resources Unit, the report was assembled with contributions from the Western Regional Archeologist, the staff of Point Reyes National Seashore, the park historian of Golden Gate National Recreation Area, scientists from the United States Geological Survey, archeologists from Texas A&M University, as well as local amateur historians and wreck divers.

This project was accomplished using methodologies from several disciplines, including history, archeology and the associated earth sciences. The field phase, of course, was primarily an exercise in scientific archeological survey. This phase was preceded and followed by different levels of historical research. A detailed survey design is presented in Chapter VI.

The management recommendations are the sole responsibility of the cultural resource specialists; the Regional Archeologist, Western Region; and the Chief, Submerged Cultural Resources Unit, in accordance with National Park Service policy guidelines. The specialists involved made specific recommendations to the Regional Director and Park Superintendent, who have ultimate responsibility for the management of the National Park System. Any reader not familiar with these organizational roles should understand that the management recommendations presented in this report are not binding nor do they necessarily reflect the opinion of the line managers of either the National Park or the National Marine Sanctuary. They are simply professional staff suggestions for consideration.

Funding

Twelve thousand dollars for this project was made available to the National Park Service from NOAA Sanctuary Programs Division, Office of Coastal Resource Management. It was used for leasing an electronic positioning system, travel and materials for artifact conservation, and other supplies. Various NPS operational accounts for unit operations funded usual salaries, travel, equipment maintenance, Coast Guard vessel fuel, and overtime costs. This project is not a programmed ONPS activity, but it has been listed in Point Reyes' Cultural Resource Management Plan. Exclusive of NPS base salaries and other normally programmed expenses, a total of $11,838.04 was expended.

Project Rationale

Established by an Act of Congress on September 13, 1962 (Public Law 87-657) and subsequently amended, Point Reyes National Seashore's enabling legislation does not specifically identify cultural resources in the key passage as follows: "That in order to save and preserve, for purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped...". However, the area's Statement for Management (approved in June 1981) discusses cultural resources and sets forth as a management objective "To identify features and events that have played a vital part in the recorded history of Point Reyes, such as earthquakes, shipwrecks..." (page 23). Knowing the location and nature of submerged resources will enable the Service to more adequately manage, preserve, study, and protect significant shipwrecks within the Seashore (Cultural Resources Management Plan 1981).

Notification and Approvals

Two published items appeared in Notice to Mariners, a Coast Guard publication, warning mariners of remote sensing equipment deployment and vessel movement. A "Scientific Research Permit" was issued to NPS by the Assistant Administrator, Coastal Zone Management, Office of NOAA, on September 14, 1982. The State Lands Commission of California granted permission to enter upon lands under their jurisdiction within the Drakes Bay locality on September 16, 1982. Letters requesting assistance from the Commander, U.S. Coast Guard, Pacific Area, and from the California Department of Parks and Recreation were responded to and an informational letter was forwarded to the State Historic Preservation Officer, Dr. Knox Mellon, on June 28, 1982.

Compliance

Since the project area and its probable cultural resources were contiguous with a terrestrial National Register of Historic Places eligible property (Point Reyes Archeological Districts and Sites), the project did not fall within the

compliance actions required by Title 36 CFR 800 but rather EO11593 and Section 206 of Public Law 96-515. The NOAA Office of Coastal Zone Management in Washington was consulted regarding NPS compliance with 15 CFR Parts 922 and 923 (Marine Sanctuaries, Coastal Zone Management). Since this project occurred within federal geographic jurisdiction, it was not subject to compliance required by California Coastal Management Program. This project was a Categorical Exclusion action as listed in Department Manual 516 DM Chapter 2, Appendix 1, item 6 ("Non-destructive data collection") in terms of National Environmental Protection Act environmental assessment.

Project Dates

The period of August 23 to September 5, 1982, was the first session of Phase I, which occured primarily within submerged lands and waters of the Seashore in Drakes Bay. Fourteen National Park Service employees from Western and Southwest Regions completed 160 persondays of work over the 14-day period. Non-Service individuals over the same period contributed 56 persondays of work. These people represented Texas A&M University Department of Civil Engineering, United States Coast Guard, and two citizens with diving skills representing Project Tektite, a San Francisco marine research and conservation-oriented volunteer organization. Altogether there were 33 active individuals, each of whom participated for at least one day, and whose work totaled 216 persondays.

The period of October 4 to October 14, 1982, encompassed the second session of Phase I, which was focused on the jurisdictions of the Seashore, California State Lands Commission, and the National Marine Sanctuary along 16 miles of coast, from the Coast Campground southeast of Limantour Spit, along 4.5 miles of Point Reyes Beach north of the Point Reyes Lighthouse. Approximately 12.5 square miles of submerged lands were covered by instrument surveys in the second session. Nine Park Service employees participated over the 10-day period, totaling 56 persondays of work. Ten non-Service individuals participated in the second session, totaling 28 persondays. These people represented the Department of Parks and Recreation, State of California, United States Geological Survey, CCM Leasing Corporation, Motorola Corporation, and three citizens were Volunteers in Parks (VIP) personnel. The total number of participants involved for at least a full day was 19. This effort resulted in 84 persondays of work.

Both sessions of the project's field operations utilized about 52 individuals for about 400 persondays, excluding many hours of communication and preparation by key people in Service and other offices.

II. ENVIRONMENT

Location

The survey area is located on the north central coast of California between 122°47' and 123°02' longitude, and 37°57' and 38°05' latitude. This location is approximately 24 nautical miles west-northwest of the entrance to San Francisco Bay (Figure 1). The first phase of the survey was conducted in two stages from August 23 to September 5, and from October 4 to October 14, 1982. All field activity occurred within the general area of Drakes Bay, around the Point Reyes headlands, and northward along the Point Reyes Beach for about 4.5 miles.

The Point Reyes Peninsula is generally triangular in shape. The eastern and longest side of this area lies along the San Andreas Fault, and the opposite angle forms the projecting peninsula of Point Reyes and the Point Reyes headlands. The most prominent topographic feature is Inverness Ridge, a line of forested coastal mountains (the highest point is 1407 feet elevation), which extends southeast-northwest along the eastern edge of the peninsula.

This ridge slopes abruptly eastward toward the fault zone that defines Tomales Bay, Olema Valley and Bolinas Lagoon. The western slopes are less steep and are drained by a number of streams within deep canyons. The middle and southern portions of the ridge are heavily forested in contrast to the western part of the Point Reyes land mass, which is a rolling area covered with chaparral and grasses.

Geology

Certainly the most prominent geologic feature in the Point Reyes area is the San Andreas Fault. This fault and its rift zone can be traced for hundreds of miles from the Mendocino County coast north of Point Reyes to the desert regions north and east of Los Angeles (Figure 2). The northward movement of the Pacific plate, of which Point Reyes is a part, was graphically illustrated during the 1906 San Francisco earthquake. During that event, Tomales Point, the northernmost point within the Point Reyes Peninsula, moved approximately 20 feet northward in relationship to the adjacent continental land mass on the east side of the fault. Even the present shape of Point Reyes seems to illustrate the north-northwest direction of movement, for it seems to be bent by forces from the northwest, contorting the peninsula into the hook that forms Drakes Bay.

The backbone of the Point Reyes Peninsula is formed by a core of igneous (granitic) rock, which gives structure and definition to Inverness Ridge. This core is overlain by a series of metamorphic and sedimentary strata. The stratigraphy of these rocks is generally uniform and extends laterally from

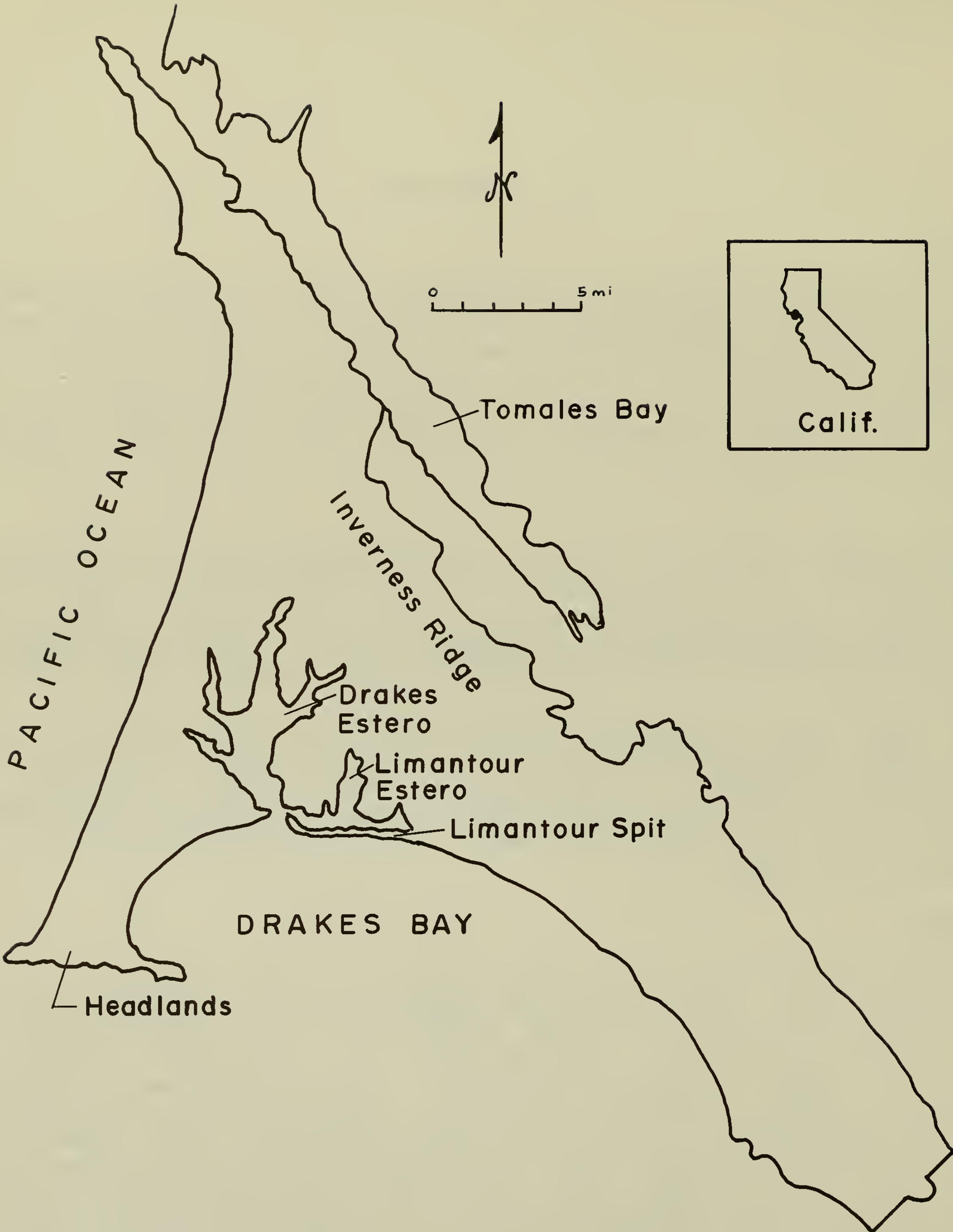


Figure 1. 1982 Shipwreck Survey Area. Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary.

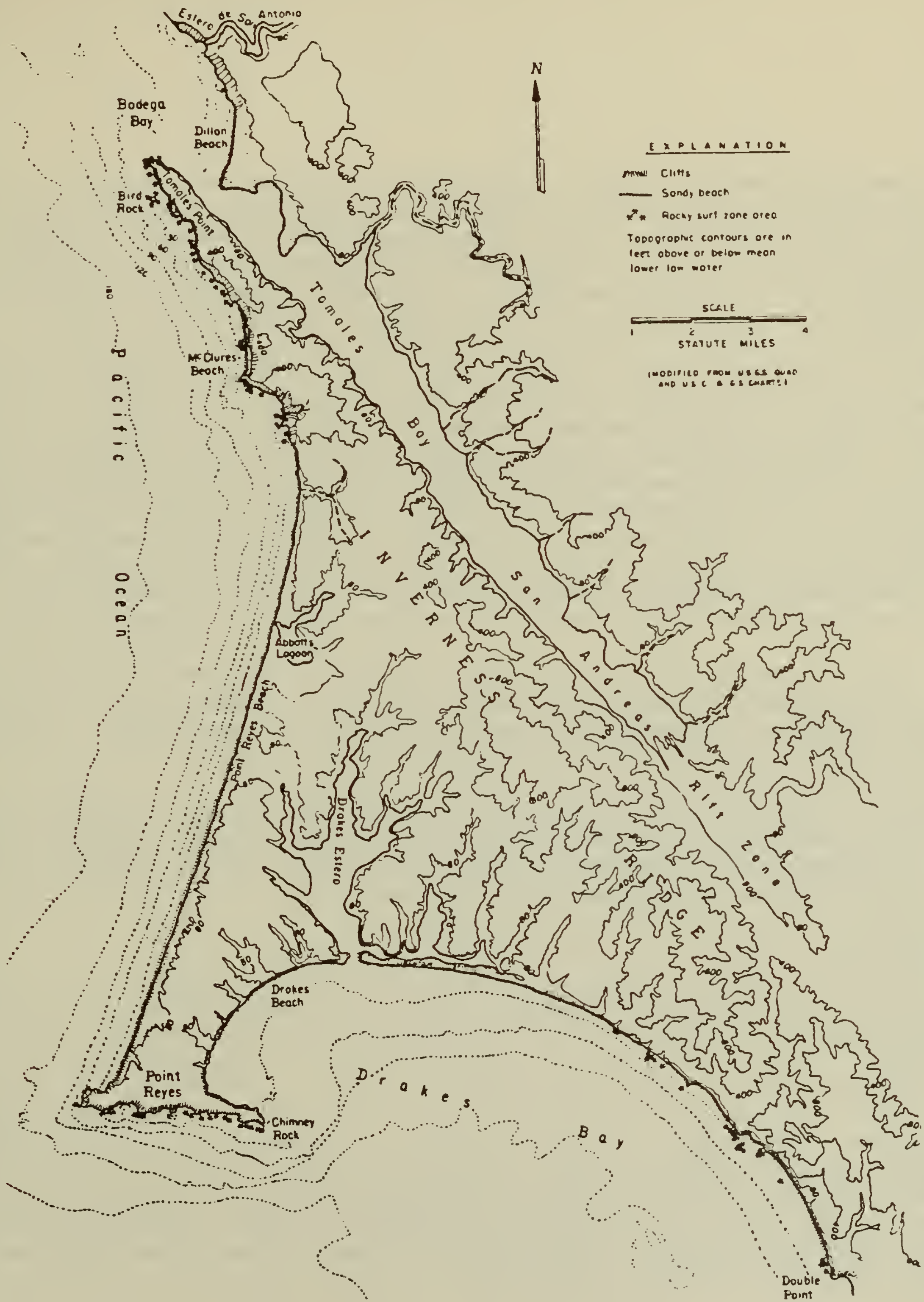


Figure 2. Coastal Physiography of Survey Area

Inverness Ridge toward the south, west and northwest. At the Point Reyes headlands, the granitic core or basement rock of the peninsula is again exposed. Here the igneous rock is overlain by a consolidated conglomerate of well-cemented sand, gravel, cobble and boulder-sized materials. The hard and resistant nature of the granite and conglomerate along this uplifting fault has created a very impressive and dramatic series of headland cliffs.

Between the headlands and Inverness Ridge, the various sedimentary rocks, marine shales, sandstones, siltstones, and claystone form a shallow dish with its centerline running northwest-southwest through the western part of Drakes Estero. These sedimentary rocks end abruptly at Drakes Bay, forming a series of cliffs. On the more exposed side of the peninsula (Point Reyes Beach) a long, narrow, and uniform beach with hind dunes has been formed. The shore of Drakes Bay has a narrow beach, and a sand spit that lies between Drakes Estero (a flooded stream valley) and the bay also helps define Limantour Estero, which lies behind the spit. Both esteros drain through a break in the spit, whose location shifts continuously east and west due to seasonal storms.

The cliffs facing Drakes Bay are claystones and siltstones of the Drakes Bay Formation, and sandy shales of the Monterey Shale Formation. These formations are generally poorly cemented and erode rapidly; in some places the cliff faces are receding at a rate of 12 inches or more a year.

Within the survey area of Drakes Bay, the immediate marine substrata are believed to be the Monterey Shale Formation and the lower sections of the Drakes Bay Formation. Overlying these substrata is a layer of unconsolidated marine sands of varying and unknown thickness.

Oceanography

The continental shelf adjacent to the survey area extends farther seaward than it does along any other portion of the west coast. This area of the continental shelf, known as the Gulf of the Farallons, reaches a width of 26 nautical miles (48km). The gulf contains two major currents that represent significant components of the northeast Pacific Ocean's circulation system. One current flows southward (the California Current), the other (Davidson Current) flows northward, and there are a number of localized eddy current systems. The California Current has a broad southerly flow, is generally close to the coast, and supplies water which is cooler and less saline than the waters farther offshore. This current normally flows along the coast from August or September through mid-November.

Toward mid-November, dominant northwest winds decline sharply. With this change in wind pattern, the cold surface water sinks and is replaced at the surface by a thin layer of warmer water. The warmer waters belong to the normally deeper Davidson Current, which runs counter to the California

Current. Once it surfaces, the Davidson Current forms a wedge between the California Current and the mainland coast. The inshore, northward, and downwelling movement of the Davidson Current usually lasts well into the winter, bringing with it relatively high surface temperatures. However, by mid-February, prevailing winds shift from the south to the northwest, thus diminishing or reversing the northward flow of surface water. As a result, the California Current flows southward, carrying surface water offshore, and deeper water that is cold and dense rises up to replace it.

During each of the seasons, local geography and topography influence local current patterns. The dominant influences of the California Current and the prevailing northwest winds have an effect on the movement of sediment in the survey area that is the reverse of what would be expected. As it flows past the Point Reyes headlands, the California Current sets up an eddying effect within Drakes Bay, and onshore waves, driven by prevailing northwest winds, meet the headlands and deflect, bending east and northward into Drakes Bay. The overall effect is a localized south and east to north and west transportation system for sediment.

The movement of sediment along the Point Reyes Beach (Pacific coast area) is altogether different. While the south-flowing California Current is the dominating element, the eddying effect caused by the Bodega headlands seems to be an effective trap for most of the sediment from the north. In comparison to the California Current, the prevailing northwest winds have a much greater effect on nearshore sediment movement. However, because of the north-northeast to south-southwest orientation of the Point Reyes Beach and the prevailing surface north-northwest winds, there seems to be no significant movement of sediment. And what sediment transport there is results in material being moved past the western extent of the Point Reyes headlands where it is increasingly influenced by the California Current and ultimately carried into deeper water off the headlands. Overall, little sediment is carried to the Drakes Bay area from the north, the sands here are derived from local and southern sources.

Climate and Weather

The climate of the Point Reyes Peninsula and its immediate environs is characterized by cool, dry, foggy summers and cool, rainy winters. Because there are upwelling, colder waters during the summer, cool temperatures and fog are very common along the coast and seaward. The reverse is generally the case during the winter months, with clear but cool weather that is occasionally interrupted by storms from the southwest.

Overall, the average range of temperatures fluctuates only about 7°F (Point Reyes Lighthouse). Inland, 20 to 25 miles away, the fluctuation in average temperatures from season to season can be as high as 20°F. For a 52-year

period, the mean temperature at the Point Reyes Lighthouse varied from 49.8°F in January to 56.5° in September. Precipitation averaged less than 20 inches per year for a period of 60 years, with a monthly mean high of 3.86 inches in January to a monthly mean low of 0.04 inches in August. High winds are common in this area, which is generally considered to be both the foggiest and windiest location on the Pacific coast. Winds of more than 100 mph are occasionally recorded. This extreme is due in part to the topography of the Point Reyes headlands. However, gale force winds along the Point Reyes Beach are also common. These high winds are most characteristic of late and early winter, and generally occur out of the north and northwest. Winter storms with accompanying winds usually confront the coast from the southeast, and as the storm system moves inland, the winds move to the northwest. End-of-storm winds out of the northwest are usually the most violent. Drakes Bay provides ships a safe refuge during the strong northwest winds. This area has the potential for unexpected changes in wind direction due to eddying conditions.

Ocean temperatures generally show little annual variation. For example, the mean monthly surface water temperatures at the Golden Gate Bridge (Fort Point, San Francisco) and at North Farallon Island range from 50.9°F to 60.2°F and 52.2°F to 56.2°F respectively, from January to December (1926-1960).

III. PREVIOUS ARCHEOLOGICAL RESEARCH IN THE PROJECT AREA

At least 14 separate large and small-scale archeological surveys and numerous excavation projects have been conducted on the peninsula between 1907 and 1979. A total of 95 sites have been recorded in the Seashore area and 20 more have been recorded at nearby Tomales Bay State Park. There has been intensive survey coverage of the Drakes Bay coast, the southwestern third of the peninsula, the entire northeast side of the peninsula, and Tomales Point, but the wooded terrain of Inverness Ridge has not been surveyed except in the Mt. Vision area.

About 36 sites have been tested, extensively excavated, or sampled by archeologists, but most of these projects were carried out on sites in the Drakes Estero, Drakes Bay coast, and Limantour Spit areas. The high level of interest in Sir Frances Drake's supposed landing somewhere within the estero has sustained such projects and researchers for many years. No formal inventory of 19th- or 20th-century historical archeological sites has been accomplished.

Prehistoric Occupation

The occupation of the Point Reyes Peninsula by the Coast Miwok native peoples is not a well-documented or a well-known period. Kelly (1978) and Merriam (1916) are the principal authors on this topic. Families and individuals of Coast Miwok or other native California groups were occupants on some of the archeological sites and other locations up to the early 1930s, but they had been displaced from their original peninsula homelands as early as the late 18th century. Discussions of Spanish, Mexican, Anglo, and modern period history may be found in Toogood (1980), Mason (1970), Munro-Fraser (1880), and the Point Reyes Historian, a local historical quarterly.

Archeological data from the numerous excavations and reconnaissance projects have been used to establish a chronology of the earliest human occupations in this section of the central California coast. These data have also been used to determine changes in cultural patterns as reflected in technology, treatment of the dead, diet, intergroup trade, and seasonal movement characteristics of these native coastal peoples. The probable ancestors of the historically identified Coast Miwok peoples are represented by the excavated materials, thus demonstrating a time depth of these historic groups. Analyses of the non-artifactual materials, such as the remains of sea and land mammals, shellfish, bird bones, and similar materials that are found on these sites, enable other scientists to observe changes in species through time, extinction, or community composition of local areas at specific times. Many sites also contain data that pertain to environmental history, geomorphology, and other earth science fields.

Archeological Evidence of 16th-Century Visits by Europeans

There is currently no archeological evidence of the first European exploration voyage that was made by Cabrillo along the North American coast in 1542. However, a later voyage of discovery, that of Sebastian Rodriguez Cermeno in 1595, can be documented by both historical and archeological data. The likelihood that certain Ming Dynasty (1573-1644-primary period of interest is the Wan-li 1573-1619) porcelain sherds and iron ship's spikes are from the wreck of Cermeno's San Agustin is high, and the distribution of these materials can be discussed from historical, nautical and technological perspectives.

Cermeno's efforts resulted in additional claims for the Spanish Crown, which conflicted with the lands claimed by Sir Francis Drake on behalf of Queen Elizabeth I. The cultural orientation of early non-Indian generations of Californians is a result of sustained Spanish claims such as Cermeno's.

Since 1940, approximately 800 artifacts of probable and known 16th-century origin have been recovered by archeologists (Von Der Porten 1965, 1968; Aker 1976:354; Shangraw and Von Der Porten 1981; Moratto 1974:61). These items include Chinese porcelain of the Wan-li period of the Ming Dynasty, about 65 hand-forged spikes or nails in association with porcelain vessel fragments, and terra-cotta and stoneware vessel fragments. For the most part, these materials have been recovered from a small number of Coast Miwok midden village sites located on Limantour Sand Spit and the eastern landforms bordering Drakes and Limantour Esteros. For example, 53 of the spikes were recovered by Heizer from site 4-Mrn-232 (see Figure 3) while five were found at 4-Mrn-235 (Heizer 1942; Meighan 1950; Meighan and Heizer 1952). From a total of slightly over 700 fragments of Chinese blue-on-white export porcelains found in 12 Coast Miwok midden sites, 235 statistically significant single sherds or sherd groups have been studied by Shangraw and Von Der Porten, who state "thirty-three percent of the porcelains were abandoned by Francis Drake in 1579 and sixty-seven percent were lost in the wreck of Sebastian Rodriquez Cermeno's San Agustin in 1595" (1981:74). Metallurgical analyses of square-shanked spikes, which varied in length from 1.25 to 11 inches, confirmed "ancient origin" (Fink and Polushkin 1941), but the much longer iron drift bolts found at site Mrn-307 may not be as old (Von Der Porten 1965:41-46).

Other enigmatic artifacts include a later 16th-century brass mortar with a pre-1604 stamp from a Nuremberg brass foundary and maker that was recovered somewhere in Marin County prior to 1950 (Von Der Porten 1973). Two copper coat buttons with fleur-de-lys designs and a hand-fashioned brass cone were recovered from Mrn-216 during excavations by personnel from San Francisco State College at this Limantour Spit site in the mid-1960s (Treganza and King 1968). The brass cone may be a shaft tip that is datable to before the

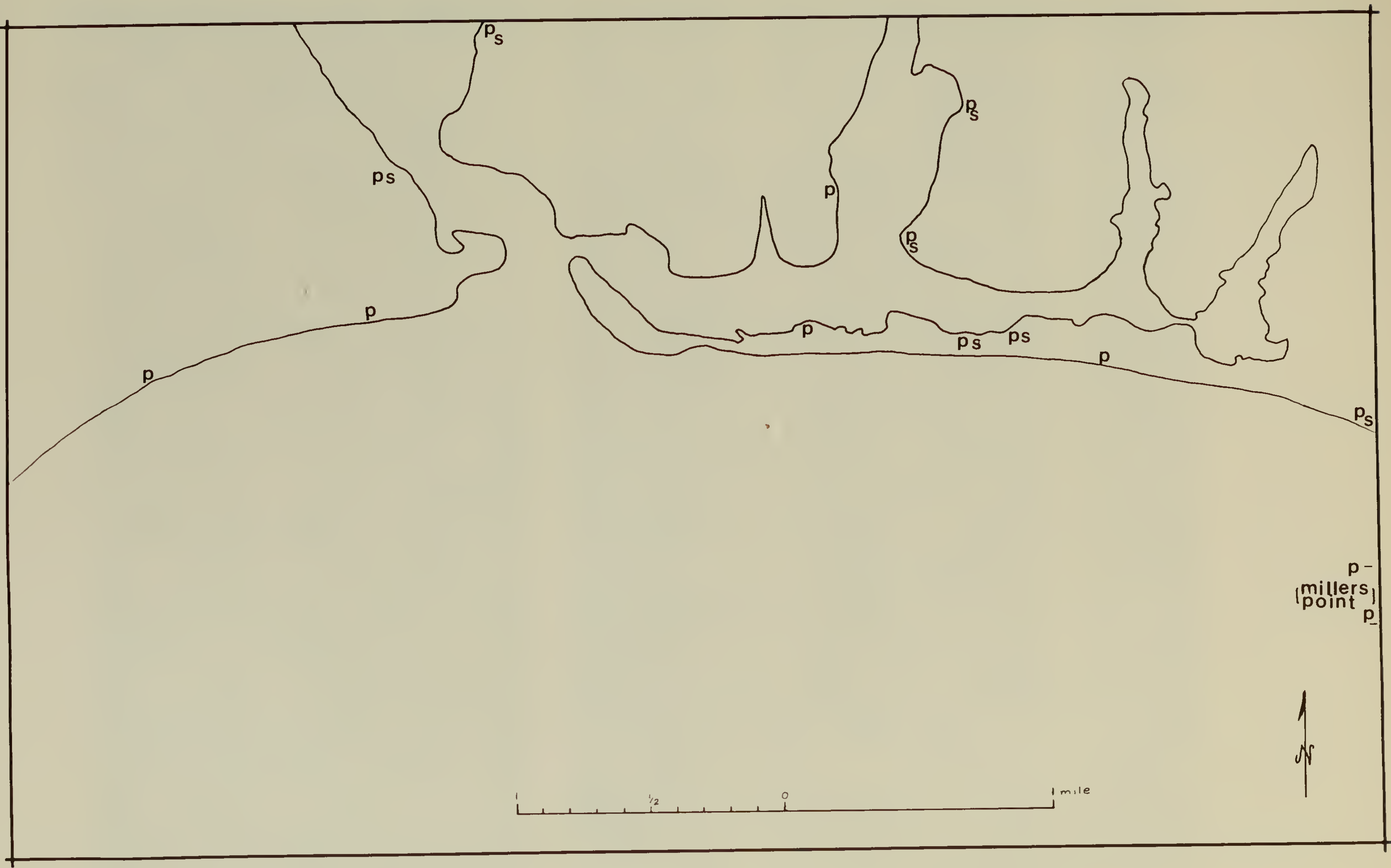


Figure 3. General Locations of 16th-Century Artifacts in the Study Area

P = Porcelain Sherds S = Forged Spikes or Nails

19th-century. Glazed brown stoneware attributable to Indo-China during the 1570-1600 period was found during excavations of a Limantour Estero site (Meighan and Heizer 1952). An apparent 16th-century Southeast Asian 'halberd' head was found in the vicinity of Mrn-281 site in the eastern portion of Marin County (Treganza 1957).

In addition to the recent analysis of the Ming porcelain, the only other restudy of supposed 16th-century artifacts has been the recent laboratory testing of the "Plate of Brass" maintained by some to be an artifact of Drake's visit to the area (Michel and Asaro 1977). It is recognized that current metallurgical procedures may result in different interpretations of iron objects found in Coast Miwok sites. The fortuitous introduction of 18th- and 19th-century vessel fasteners into coastal or estero locations, including archeological sites of precontact or historic time periods, should be considered when future archeological projects or accidental discoveries reveal these objects. Shipboard metal artifacts should not be attributed to 16th-century origins without metallurgical analysis to establish the probable date of manufacture.

Within the past three years, three sherds of Ming porcelain have been recovered on beach or shore locations (Figure 3). A visitor found and returned to park staff a large sherd from the Drakes Beach day-use area in 1980, and a smaller piece was found along the leeward edge of Limantour Sand Spit, opposite the mouth of Limantour Estero, by a local district ranger in 1982. Another large sherd, possibly of Cermeno vintage, was recovered by Seashore staff on Limantour Spit, about a mile west of the day-use parking lot.

<u>The 1965-1966 Magnetometer Survey at Drakes Bay</u>

As early as December 1963, discussions between John Huston of San Francisco (founder of the Council on Underwater Archeology), Adan Treganza of San Francisco State University, and Paul Schumacher (then NPS Regional Archeologist) had clearly identified a need for an underwater inventory of historic and archeological resources within Point Reyes Seashore, established by PL 87-657, September 13, 1962. About two years later, Treganza, Schumacher, Huston, Sheldon Breiner (then of Varian Associates, Palo Alto, California), and Frank Rackerby, also from San Francisco State University, visited the Limantour Sand Spit with a rubidium magnetometer owned by the Palo Alto firm. On January 8, 1965, this party, accompanied by other Park Service staff from San Francisco, successfully tested the rubidium magnetometer "along the flats to check its ability to detect metal objects" (as noted in Schumacher's office files). A purchase order in the amount of one thousand dollars was issued on March 11, 1965, to John Huston, acting for the Council on Underwater Archeology (CUA), who then began a series of field visits with personnel from Varian Associates, Council members, and interested citizens as

volunteers. Since the rubidium marine magnetometer had been developed and patented by Varian Associates, Drakes Bay/Limantour Spit became the first area in the United States in which there was a systematic marine application of this type of magnetometer (Breiner 1965:9; Huston 1966).

The project began with a field session between March 12 and 15, 1965, in which three staff members from Varian Associates, two CUA members, a civil engineer from UC Berkeley, an engineer associated with General Electric, and several divers were lead by Huston, who wrote a short project summary on April 20. In this document, Huston outlined goals, preliminary results, and future activities of the project as follows:

1. Study the operation of the rubidium magnetometer, using the sensor in a boat as well as below the water.
2. Study methods of mapping by which the recordings of the magnetometer can be superimposed upon a map of the area.
3. Study methods of mapping on a grid system following lines of buoys and automatic correction of position by land instrumentation.
4. Make a preliminary study of a portion of Drakes Bay aimed at possibly making finds of historical interest.
5. Search more intensively in certain areas with the hope of discovering remains of the debris left by Sir Francis Drake and remains of the Cermeno Manila galleon sunk in 1595 (Huston 1966).

Huston's comments on preliminary accomplishments indicate that the field party successfully operated the magnetometer aboard a 12-foot skiff that was kept on a direct linear course. Positioning with land-based points was effective, but Huston concluded that additional points were necessary and that a stadimeter would be utilized. A number of "strong anomalies" were recorded and some idea of the bottom topography was gained. Several newspaper articles that generated citizen interest said that Huston was "...optimistic as to finding items of significant historical value in Drake's Bay." His April project statement ended with recommendations for logistic and equipment coordination, including "walkie-talkies," new surveying methods, and an "attempt to obtain better boats and equipment."

Between March and December of 1965, Huston consulted with geologists, Point Reyes ranchers, experts on Ming ceramics, historical sources in San Francisco, Manila, and Seville, naval architects regarding armaments, and "six companies regarding additional geophysical equipment for further mapping or charting of sub-bottom anomalies of the Bay" (Huston to Schumacher, December 1, 1965). These activities included four weekends and "several hundred hours on research and preparations."

On at least two separate occasions during 1966, Huston visited Limantour for further work, but it is unclear what activities were accomplished. On March 25, Schumacher visited Huston at Limantour Spit and on September 17, Huston was in the field with three students. His death in San Francisco on March 29, 1968, ended the project before a detailed report was prepared, although a diagram of the Sand Spit offshore study area was drafted, showing four anomalies (see Figure 4).

In retrospect, the following aspects of this 1965-66 project are significant:

1. It was demonstrated that the rubidium magnetometer could effectively record magnetic anomalies of cultural origin from a towed line or specially designed diving plane, guided by a diver (Breiner and MacNaughton 1965; Breiner 1965; Langan 1965).

2. In shallow waters (8 meters according to Breiner 1965:9 or 20 feet according to Breiner and MacNaughton 1965), traverses totaling 8 km long and about one-eighth km apart were made within a zone .50 km from the shore line. These traverses and vessel positions were mapped by triangulation from two shore-based transits (Langan 1965).

3. A cluster of three sizable anomalies and a smaller one were recorded, but no information on gamma readings or possible historical identification is available.

4. In comparison with the proton magnetometer, also manufactured by Varian Associates as a primary oceanographic tool, the rubidium magnetometer as a field-designed prototype was judged better for search and "salvage" purposes than the previously developed proton magnetometer (Langan 1965). Interestingly, Breiner and MacNaughton believed "...it will be...a few years before the magnetometer is exploited as successfully underwater as it has been on land" (1965:10).

5. It is unclear whether any artifactual materials were collected or recovered from bottom sediments at anomaly locations, but "a complete four pound practice bomb and many bomb parts" were encountered during the magnetometer sweep of the Sand Spit (Treganza and King 1968:25). Excavations at nearby Mrn-216 produced seven additional items of modern ordnance (Treganza and King 1968:Appendix A) Huston did note in September 1, 1965, that "artifacts have been found to be much more widely distributed than we had anticipated...." Breiner's observation that "a few large iron objects in shallow water, most likely pieces of modern ships frequently found in that bay" indicates that some "ground-truthing" of anomalies was done by divers during this survey.

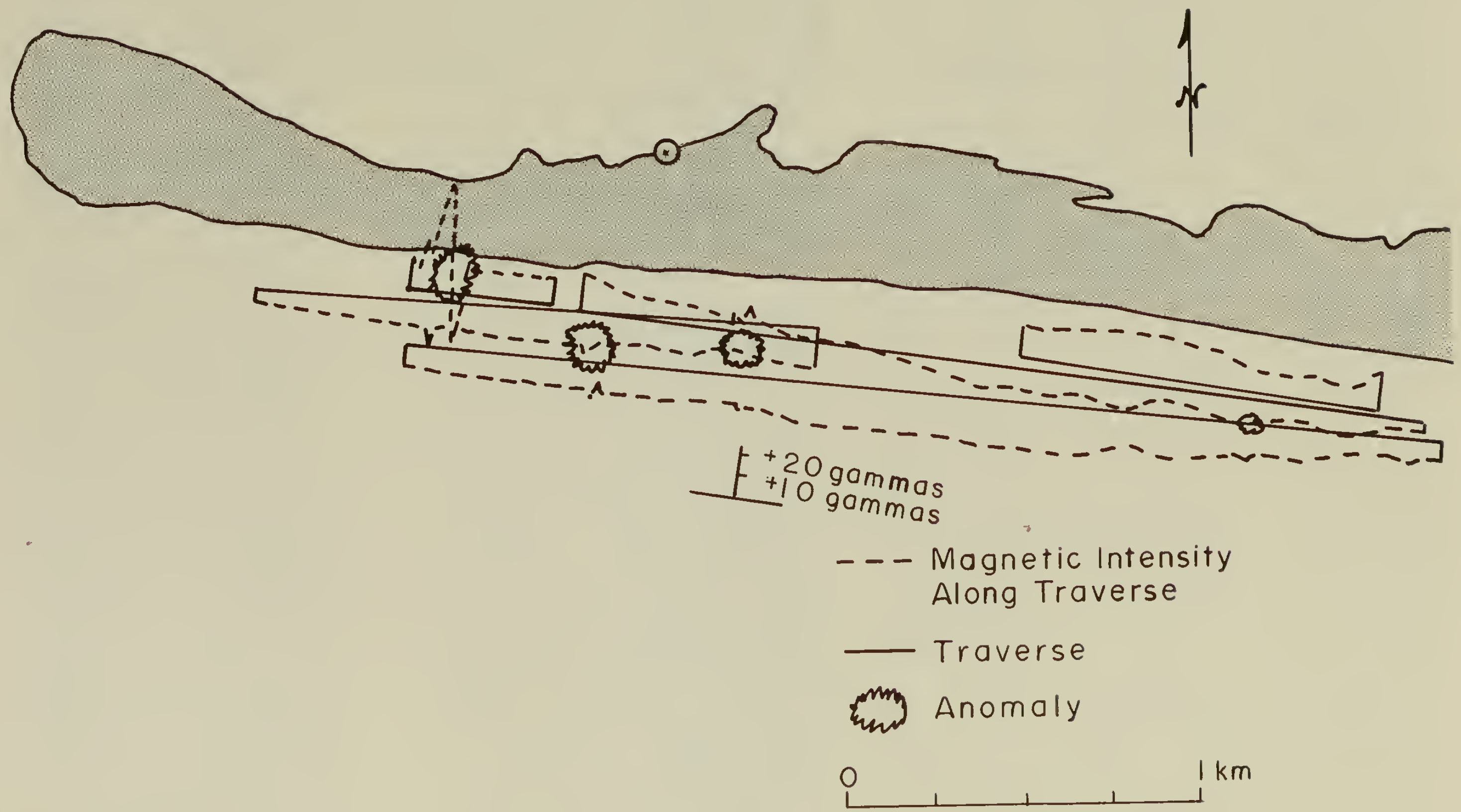


Figure 4. Profiles of Total Magnetic Intensity in Drakes Bay. Measurements were obtained from a rubidium magnetometer towed behind a boat. Data was collected during the 1965-66 survey. Large anomaly cluster close to shore may be the engine block of <u>Pomo</u>. (Diagram adapted from Breiner 1965.)

6. Huston's April 1965 statement clearly indicated the need for coordinated logistics, radio communication, a positioning system from land points to vessel, the compilation of historical and earth science data, media attention and public interest, various specialists, and a clear project design. Technical reports were prepared by staff of Varian Associates for professional use.

7. It is likely that the Huston-Park Service Magnetometer Survey project located the remains of Pomo, a steam schooner carrying lumber toward San Francisco, which was grounded on December 31, 1913. Pomo's triple-expansion steam engine block was visible during the 1982 project and divers explored the location, observing some artifactual materials nearby. An Army Map Service map (AMS Series V795, Sh 1460 III) based on aerial photography done in October 1947, shows a shipwreck symbol at approximately the same location as the anomaly cluster of 1965, and the visible engine block observed in 1982-1983 (Plate 4).

1967 Search for Shell Oil Company Barge Anchor

In 1967, Sheldon Breiner of Varian Associates conducted a magnetometer search for a 40-ton anchor and chain that had been jettisoned from an oil-exploration barge about 1.5 km northeast of Chimney Rock. A cesium magnetometer was used to record a 10 gamma "hit" at a depth of 45 feet. An estimated distance of from 100 to 200 feet between the object and the sensor produced a "hit" of this magnitude on a 100-gamma full-scale sensitivity. The objects were not recovered (Sheldon Breiner, personal communication September 9, 1982).

IV. POINT REYES EARLY MARITIME HISTORY

Historically, the inhabitants of Point Reyes were significantly affected by the boats and ships that sailed into this area. At one time they were dependent on maritime commerce. However, this was not the case until the 19th century. Prior to that time, the area was inhabited by the Coast Miwok (Hookooeko) Indians, who constructed small tule (reed) boats for use on the bays, but apparently did not build ocean-going vessels. For brief periods during these centuries, ocean-traveling vessels entered Point Reyes waters. Juan Rodriguez Cabrillo, Francis Drake, Sebastian Rodriguez Cermeno, and Sebastian Vizcaino were among the early explorers who traveled through this area.

In the late 18th and early 19th centuries, Aleuts hunted sea otters up and down the coast for Russian, English and American traders. By the time the sea otter trade was diminishing, along with the number of sea otters, an ever-increasing number of foreign ships had begun to use San Francisco as a port.

In 1776, the Spanish mission system reached the San Francisco Bay area. During the following decades, the Coast Miwoks were moved from their homes to the missions. In 1821, Mexico gained its independence from Spain. After Mexico secularized the missions in 1834, it granted the mission lands to individuals who had served the government. The land, including Point Reyes, was soon divided into private ranchos.

The rancho lifestyle was supported by the ships that brought manufactured goods to the area. The hides and tallow that were produced from the ranchos' cattle and the native tule elk were traded for manufactured goods that were brought into the San Francisco Bay area by the trading vessels. Without this maritime commerce, the rancho families would not have been able to enjoy as comfortable a lifestyle as they did.

Ranches and Schooners

In the 1850s, dairy ranches replaced the ranchos, and Americans gained ownership of the land from the Mexicans. Commercial dairy ranching in California was begun by tenants who produced cheese on their ranches. Soon a privately owned and operated dairy ranch on Tomales Point and a series of tenant ranches on Point Reyes were producing butter and hogs for market.

During the earliest dairy operations, the cheese was shipped from Limantour Estero and a landing on Tomales Bay. The later operations also relied on water transportation for their products. The ranchers transported boxes of

butter to San Francisco on schooners. They also transported hogs, which had been fattened on the buttermilk left over from the butter-making operations. Calves and lambs were slaughtered and transported to market.

Over the years the ranchers used wharves on Drakes Estero, including those on Schooner Bay and Home Bay inside Limantour Estero and on Tomales Bay at White Gulch and at Lairds Landing. The longest of the schooner landings was a 200-foot pier that was built into Schooner Bay after 1879.

The schooners came once or twice a week, bringing feed and grain to the ranchers from San Francisco. Larger schooners from Santa Cruz brought redwood lumber for building ranch structures. The schooners that traveled between Point Reyes and San Francisco included Fourth of July, Colonel Baker, Frances, Valentine, Alviso, Nettie Low, Ida A, Etta B, Jennie Griffin, Annie and Point Reyes.

Nettie Low, built in 1892, was owned by Captain Thomas Low of San Francisco. It was the first gasoline-propelled boat that was operated regularly between Point Reyes and San Francisco. In 1900, while carrying grain and merchandise to Point Reyes, it capsized and sank three miles south of Double Point.

Ida A was a gasoline schooner with a wooden hull. On one occasion an oarsman on Ida A fell into the Estero and drowned. In another incident, on March 12, 1912, Ida A was anchored in Drakes Bay, when it lost its anchor and drifted onto the beach. The Point Reyes Lifesaving Station crew attempted to free Ida A by setting an anchor offshore and having the ship pull on this anchor. Fifteen tons of cargo were removed from Ida A, and the ship eventually got free.

Several Point Reyes ranchers pooled their resources and bought a schooner to replace Ida A. They named this schooner Point Reyes and used it to carry passengers, hay, sacked feed, lumber and groceries.

In addition to the schooners that travelled between Point Reyes and San Francisco, numerous other schooners passed by Point Reyes on their trips between various ports. This was a treacherous area, and 29 schooners are among the ships and boats known to have become stranded or wrecked in the waters near Point Reyes.

The esteros slowly silted in as the soil was washed down from the adjacent hills that had been subjected to intensive grazing. Ranch roads were improved, new roads constructed, and the Point Reyes ranchers ceased to depend on maritime commerce, turning to land transportation to move their products to market.

Point Reyes and the Fishing Industry

Toward the end of the 19th century, Drakes Bay was frequented to a much greater extent by fishing vessels as well as by schooners. During the 1890s, companies that sold fresh fish in San Francisco began to fish in Drakes Bay and the adjacent waters. The use of trawling techniques, developed around this time, resulted in intensive fishing of the area. Two steam tugs, dragging a net between them, traveled against the tide in Drakes Bay. They completed the course between Double Point and Point Reyes twice daily. Each time the net was filled with approximately 5 tons of marine life, including large numbers of flounder, sole and rays. The best of the catch was kept, while the rest was returned to the sea.

Eventually, buyer barges were sent out from San Francisco and were anchored in Drakes Bay. Here the fish were cleaned and then transferred to delivery boats, which took the catch to San Francisco.

Later, wharves were constructed on the western edge of Drakes Bay. The first of these was built around 1919, by the F. E. Booth Company. The pier was later used by Ignacio Alioto's Consolidated Fish Company. After 1941, it was used by the F. Alioto Fish Company. In 1978 the pier was demolished.

Another pier was built west of the Booth Company pier. It was too high and was demolished in 1947. A substitute for this pier was built east of the Alioto pier. This is the only one of the commercial fishing piers in Drakes Bay that is still standing. Today this pier is used by the California Shellfish Company.

In 1923, A. Paladini, Inc. built a pier east of the Booth pier. The Paladini pier burned in 1970.

The 19th-century fishermen operating out of San Francisco were primarily Genoese, who used feluccas, lateen-rigged, plumb-sterned sailing vessels, and Chinese, who sailed in traditional junks. By the time the piers were built in Drakes Bay, most of the fishermen who used one-man boats were of Sicilian extraction. More recently larger boats and crews were used.

By the 1920s, the deeper waters were being trawled. Salmon, pompano and albacore were among the fish caught. At times, 150 to 200 boats brought their catches to Drakes Bay, where they were transferred onto delivery boats. During the 1930s there was a short lived attempt at whaling.

Delivery boats transported the catch to San Francisco until the Sir Francis Drake Highway was opened. After that, the catch was trucked to market. Trucks are still used, but the piers' use declined after modern fishing boats with on-board fish-cleaning and refrigeration plants came into use.

There are still fishing boats working in the waters along Point Reyes, and Drakes Bay is still a popular shelter during storms.

Maritime Commerce at Point Reyes During Prohibition

During prohibition (1920-1933), rumrunning was one important aspect of maritime commerce at Point Reyes. Ships that carried liquor from Canada and Mexico remained offshore as the cases of liquor were transported to the beaches of Point Reyes. The beaches along Tomales Bay were used most often. The liquor, mostly Scotch, was either moved to a truck on Point Reyes or was transported by sailboat across Tomales Bay to a truck on the other side of the Bay. Eventually a black motor launch was used for the trip across Tomales Bay.

Isolated and sparsely settled, coastal Point Reyes was an ideal location for bootlegging. Many people were involved and even more were aware of the clandestine, nocturnal activities on Point Reyes during this era. Federal agents found themselves at a disadvantage when they attempted to stop the illegal trade. When the 18th Amendment was repealed in 1933, this aspect of maritime commerce along this coast ceased.

Point Reyes During and After World War II

During World War II, the lives of the inhabitants of Point Reyes were once again affected by their location along the coast. The threat of a Japanese submarine attack in the area was taken seriously by the United States military organizations. Offshore patrols were maintained by the Navy. The 30th Infantry had a training camp on Point Reyes, the Army had long-range gun installations, the Army Air Force used the beaches for target practice, and the Coast Guard patrolled the beaches. The anticipated attack never materialized, and by the end of 1943, full beach coverage was no longer considered necessary. This military activity has contributed to the ferrous material within the survey area.

Since World War II, fishing boats and pleasure boats have used Drakes Bay and Tomales Bay. However, the brigs and schooners, the schooner landing, and most of the fishing industry's piers are gone; the ships that pass Point Reyes today contain sophisticated electronic equipment that reduces the risk of wrecking in these waters, which have claimed so many vessels.

V. DRAKE AND CERMENO EXPEDITIONS

There are few other stretches of coastline in the United States that have as much written about them as Drakes Bay. Most of this attention is focused on the period 1579 to 1595, during which Sir Francis Drake may have visited the bay, and Sebastian Rodriguez Cermeno almost certainly did. The plethora of secondary literature is unfortunately based on remarkably little in the way of substantive primary sources, and consists largely of papers in which adversary positions are passionately maintained regarding the question of whether or not this was Drake's anchorage.

Drake Expedition

The first European to land in Alta California was probably Sir Francis Drake in 1579. Archival documents describe in some detail the point where he landed to careen his vessel, and what is now known as Drakes Bay may very well be the scene of that historic event. It is not within the scope of this report to review the controversy over Drake's landing, except insofar as it has implications for the proposed survey. Interest in Drake's sojourn is related primarily to any material remains that might have been contributed to the archeological record.

Most of the 16th-century European or Oriental materials from several different excavations of aboriginal sites at Drakes Bay (see Figure 3) have been attributed to the Cermeno expedition. The most notable exception to this interpretation is Von Der Porten's (1973) argument that the non-waterworn samples from the sherd collections resulted from Drake's visit. The argument offered is interesting, but unfortunately assumes the nature of a tautology where the hypothesis is used to prove the assumption. For the purposes of this report, the significant aspect of Drake's possible visit is that he may have left a small support vessel in the bay when he departed to complete his circumnavigation of the world. Each source of information will be briefly examined, but the focus will be on this issue, since the possibility that there was another 16th-century craft in the bay has obvious bearing on any survey work.

The World-Encompassed (1628), a narration by Sir Francis Drake (nephew to the great mariner of the same name), is compiled from a number of sources, primarily from notes made by Fletcher, Drake's chaplain on the great voyage. Unlike Henry R. Wagner who felt that this was "the most untrustworthy account" of Drake's voyage (Wagner 1926), Warren L. Hanna sees it in a much more benign light. Hanna implies in his discussion of the accounts (1979:100) that The World-Encompassed (1628) is probably the most complete and accurate source, and that Hakluyt's version in The Principal Navigations (1589) was subject to too many editing and publishing pressures to be as accurate. These two documents

and "The Anonymous Narrative" are the major primary sources for information about Drake's visit. None of these gives us any reason to believe that there was a second ship with Drake that was abandoned in "Nova Albion," as he called the bay.

All allusions to the second ship seem to stem from one single comment from a primary source - a translation of the "Second Declaration of John Drake" before a Spanish inquisition in Lima (1587). This is found in Zelia Nuttall's New Light on Drake (1914:51), published by the Hakluyt Society. The statement is: "Here he caulked his large ship and left the ship he had taken in Nicaragua."

This seems to refer to the 15-ton vessel of Rodrigo Tello's that was taken by Drake's men on March 20, 1579. There is no question that Drake took the vessel and that he eventually departed Guatulco with it. This is confirmed in at least three testimonies by captured passengers (see Nuttall's 1914 translations). Hanna consistently refers to this vessel as a frigate in his recent publication (1979:49, 64, 240). By this, of course, he does not mean the modern day connotation of frigate (a three-masted, multi-decked, square-rigged warship usually associated with the 18th century), but rather to the early Spanish term fregata. Additionally, Hanna tells us that, given the tonnage of the fregata (15 tons), we can estimate that it was 38 to 40 feet long, 10 feet wide, with a draft of about 5 feet.

Wagner defines a fregata in the context of a different document (Declaration of Ladrillero 1574, in Wagner 1924a:39, Footnote #3) as "a word in general use among the Spaniards in the sixteenth century for any full rigged vessel which did not have the numerous decks of a man-of-war." Samuel Eliot Morison (1974:628) defines a fregata as a "bergantina" or "a small open vessel." Ervin Scandurra says of the fregata in A History of Seafaring (1972:210) that:

> The fregata, or frigate, was the galley's service-boat from the thirteenth to the sixteenth century. Rowed by eight to ten men, and having one lateen sail, it was usually towed by the galley's flagship. Only at the beginning of the sixteenth century did it become a sailing ship used for exploration.

It is interesting that Scandurra also says that the "bergantino" (which Morison uses interchangeably with fregata) was:

> ...a fast, undecked ship widely used in the fourteenth century, but gradually increasing in size and later used even in the Atlantic on voyages of exploration... (Scandurra 1972:210).

We are unaware of any primary source in which Tello's ship is referred to as a "fregata." It is always referred to as a "Bark", or more properly a "barca," and if Hanna does have a primary reference for his definition of fregata, he has not shared it with us in his notes or bibliography.

This issue is further clouded when we note that both Hanna and Wagner, without remarking on her intriguing footnotes on the same page, use the above-mentioned reference from Nuttall to confirm the abandonment of Tello's vessel. Nuttall states:

> It would seem as though John Drake must have said "the pinnace made in Nicaragua" and that the secretary of the Inquisition made the mistake (Footnote 1).
>
> Here again the wrong idea is conveyed that he went to California with two vessels, instead of his ship and the pinnace (Nuttall 1914:51, Footnote 2).

Although the only actual primary source refers to the craft as a 15-ton bark, there are two additional comments by witnesses who describe Drake's intentions of modifying the craft before heading for Alta California:

> They were going to strengthen the bark with a solid wale so as to enable her to carry more sail and be fit for the long voyage she would have to make in order to reach the Moluccas; for the launch could not make this crossing (Nuttall 1914:184).
>
> For he did not know in what necessity he might find himself on the ocean and that he was going to take the bark on board his ship and fit her out with more oars and a main-top-sail (Ibid:188).

Hanna may be correct that a fregata of the size he describes was left at Drakes Bay by Sir Francis, but as far as we can tell, anything beyond the above-quoted primary sources is simply an educated guess. One thing that we can be sure of is that the vessel was not a frigate, a brigantine or a bark, as they are currently defined. None of these modern-day terms is related so closely to its archaic meanings that it can be used interchangeably without causing needless confusion. For the purpose of this report we will use the terms fregata, bergantina, barca (also spelled barque), and lancha.

The sketch of a barca (Figure 5) was taken from the Dictionario Illustrado de Artilleria (1866). Although it is a comparatively modern treatise, it is noteworthy since one of its major purposes was to illustrate ancient weaponry and vessels that were listed by their archaic names.

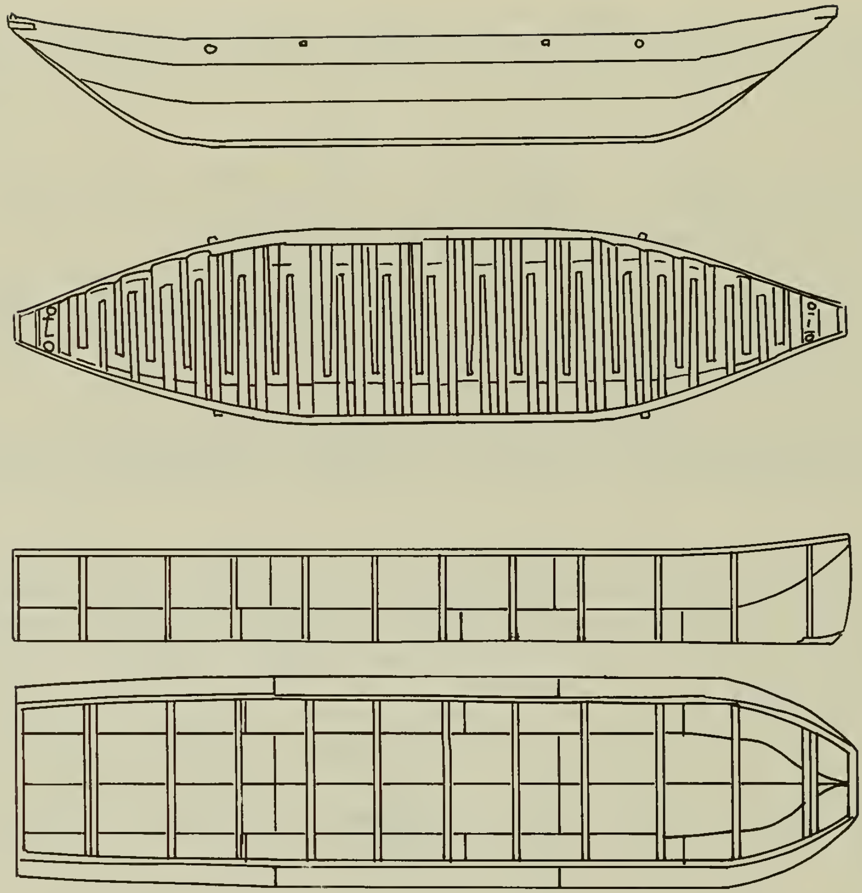


Figure 5. Early Spanish Barca (From Diccionario Illustrado de Artilleria, 1866)

We are left with the following few bits of information about the vessel that have been derived from contemporary sources.

1. Drake definitely left Guatulco with a 15-ton "barca" that he "liberated" from one Rodrigo Tello.

2. This vessel may have been left at the anchorage (Drakes Bay) if we can give credence to the comment of John Drake before the Inquisition.

3. It was large enough to carry a cargo of maize, honey, sarsaparilla, and planks as well as 14 passengers.

4. It apparently was not armed when "liberated," since Drake's men were able to take it, without resistance, from their own ship's launch.

If this vessel was left at Drakes Bay, it would probably have been stripped of any heavy iron apparel or cargo, and the only ferrous remains that might trigger an anomaly on a magnetometer would have been the ship's fittings. If it was left inside the estero, it most likely would have been salvaged by the aborigines in the area.

For the purposes of the remote sensing survey, we can assume there could be little or no confusion between the remains of this vessel and those of <u>San Augustin</u>. Although isolated late 16th-century artifacts, such as porcelain and spikes, could have been left by either expedition, there should be little problem in identifying Cermeno's vessel.

<u>Cermeno Expedition</u>

Unlike the controversy over Drake's visit, there is very little question concerning whether or not Sebastian Rodriquez Cermeno (various other spellings include Zermenyo and Cermenho) lost <u>San Agustin</u> in 1595, in what is now known as Drakes Bay. The reason for this comparatively high level of confidence in Cermeno's presence in the area is that there is a personal account of his journey down the coastline to the place where his vessel was lost, while he and most of his crew were on shore. This "Declaration" was translated by Henry Wagner in "The Voyage to California of Sebastian Rodriguez Cermeno in 1595" in the <u>California Historical Quarterly</u> (Wagner 1924).

The various accounts relating to the expedition were secured from the archives of the Indies in Seville. Although they seem to confirm that Drakes Bay is the location of the wreck of <u>San Agustin</u>, and they contain a detailed description of his subsequent odyssey in the ship's launch down the coastline back to Mexico, there is only the briefest allusion to the actual wrecking of the vessel. This may be because a separate Declaration (which has not surfaced yet) was taken to

explain in detail the loss of the ship. It is also possible that it never will be found if it was considered the equivalent of a modern "top secret" military document. It is also significant that there is absolutely nothing in Cermeno's description of the area that would suggest that there had been some earlier European contact (i.e., Drake). If this was the site of "Nova Albion," it is hard to believe that no vestiges of Drake's lengthy sojourn would be visible to the Spaniards. It is possible that a secret account also exists that identifies evidence of Drake's discovery of the bay in June 1579. "Discovery" often held the connotation of "laying claim to" in 16th-century New World endeavors by Europeans, and the suggestion that Drake had laid legal claim to the area could be a frightening one.

For the purposes of the 1982 survey operation, the most significant aspect of the Cermeno accounts would be any clues to the possible location of material remains from San Agustin. Considered in this light, the amount of information relevant to underwater archeological concerns is very limited.

Raymond Aker, a maritime historian associated with the Drake Navigator's Guild, has produced a comprehensive analysis of the portions of the Wagner translation that relate directly to the location of the wreck, and has settled on a probable site just seaward of the present mouth of Drakes Estero. He was assuming that, in 1595, the actual cut through Limantour Spit was located east of its present location.

The step-by-step rationale that Aker develops to justify his conclusion is well-thought-out and unfortunately may be proven correct. It would be unfortunate because it would place the vessel within or very near the existing breaker zone at the mouth of the estero. This area would be extremely difficult to survey adequately, and next to impossible to excavate for the purpose of ground-truthing any remote sensing anomalies. An analysis of Aker's data by Submerged Cultural Resources Unit Archeologists revealed that the wreckage could possibly be as much as 1.5 miles west of his projection and out of the present breaker zone. The logic for this conclusion, presented below, is based on some very slight differences in the interpretation of documentary evidence. This Park Service theory, if it is correct, would put San Agustin almost squarely on the point where the magnetic survey revealed a high-duration, low-level magnetic anomaly that may represent a shipwreck. Underwater investigation of the area by Service divers revealed nothing protruding from the bottom, but did result in several "contacts" with a metal detector. Only test excavation can confirm whether or not the anomaly is related to a shipwreck, and whether the wreck in question is indeed San Agustin or whether it is related to the remains of several other vessels that have come to grief in approximately the same area.

Our analysis of information from primary sources is aimed entirely at determining the location of the anchorage of San Agustin, and projecting where it might have wrecked after being blown from its mooring during a southerly

gale. It is important to note that, in order to reconstruct events and to predict the present location of the wreckage, we must make two assumptions.

1. We are assuming that the section of coastline being described in the Declaration is indeed the Point Reyes/Drakes Bay area. This assumption can be made with a fair degree of confidence, since others have amply demonstrated that this is the only bay that would fit the primary source descriptions (e.g., Aker 1965).

2. We are assuming that the ship's anchorage was never changed from its initial position before the storm, and the skeleton crew left on board did not manage to get the ship under way before it wrecked.

With these assumptions in mind, we will list without comment all of the known primary source references to the anchorage site and subsequent wreck site of the vessel, and then offer some observations.

The following is from the original account of Sebastian Rodriguez Cermeno and is signed by him.

> ...As the weather was severe we kept getting near the land, and having reached it, a morro was discovered, which makes a high land and seemed like the Punta del Brazil of Tercera. Running along a musket-shot from the land, we saw a point which bore northwest, and entering by this we saw that there was a large bay. Here I went on casting the lead, with the bow headed north a quarter northeast, with the bottom of the sea of sand, and went on to seven fathoms, where I anchored. The point on the west side bore south-west quarter west, and the one on the east, south-southeast. The bay is very large and shaped like a horseshoe, and a river runs into it, and on the bar at high tide there are three fathoms of water, and from the bar outside to the entrance of the anchorage there is a distance of two shots of an arquebus. Having anchored in this bay, we saw in the middle of it three small islands which bore south-south-west, and to the south a small island of half a league in size. The islands trended northwest-south-east. The land is bare. The river above referred to enters into the land three leagues and has a narrow mouth, while above in some parts it is a league in width, and in others a half a league. On the west side it has two branches of half a league each, and on the east side one, the entrance of which is a matter of a quarter of a league from the bar... (Wagner 1924:12).

> ...The land seems fertile as far as three leagues inland, according to what I saw and what the other Spaniards saw whom I took with me to seek food, of which there was need on account of the loss of the ship...(Ibid:13).
>
> ...On Friday morning the 8th of December, we left the bay and port of San Francisco--or as its other name is, Bahia Grande--where we were shipwrecked. This bay is in 38 2/3^{o} and the islands which are in the mouth [of the bay] are in 38 1/2^{o}, and from one point of the bay to the other there may be a distance of twenty-five leagues... (Ibid:14).

The following is from a Declaration made by Cermeno on November 30, after he and the expedition survivors arrived in Chacala.

> In the port and bay of the new discovery of Cape Mendocino in the camp of Santa Fe, the 30th of November, 1595, before me, Pedro de Lugo, escribano of the King our master, Captain Sebastian Rodriguez Sermeno, chief pilot of the said discovery, Said that by reason of having lost, while at anchor in the port, the ship San Agustin which he brought and which Captain Pedro Sarmiento had offered to the King in Manila, without being able to save any of the supplies and other property which was on board,...

Lastly, the Bolanos-Ascension Derrotero, which was translated by Wagner (1926), but which we have taken from Aker (1965:63), states:

> ...It is called "La Punta de los Reyes" and is a steep <u>morro</u>. On its northeast side this furnishes a very good shelter, making it a good port for all ships. It is in the latitude of 38 1/2^{o}. Note that in anchoring in this port, called "San Francisco," for shelter from the south and southeast winds, you have to do so at the end of the beach in the corner on the west-southwest side...
>
> ...Here it was that the ship <u>San Agustin</u> was lost in 1595, coming on a voyage of exploration. The loss was caused more by the man commanding her than by the force of the wind...

The only additional piece of information that is available in a primary source is a comment in the Declaracion of Cermeno before Pedro de Lugo, Scrivener of the King. Although most of the relevant text is a repetition of his "account" quoted above, one significant comment is added: "The ship anchored in the bay and port about a quarter of a league from shore" (Aker 1965:54 as taken from Wagner 1926).

Aker makes a convincing argument for the site of the anchorage being about one-half mile offshore from the present high ground on the east side of Drakes Estero. This is based on the assumption that in relating the three compass bearings Cermeno took from the anchorage, the point on the west side (which bore southwest-quarter-west) was indeed the highest point on the west end of the headlands. It also assumes that the point on the east (which bears south-southeast) is a mistake on Cermeno's part.

This analysis is probably correct; however, it is worth noting that if there was a severe compass aberration when he took these readings, and the only element one could count on was consistency of error (measurable in degrees) between his south-southeast reading and his southwest-quarter-west bearing, then we are left to explore with a three-arm protractor where the apex of a 79° angle would be located in the anchorage. It happens that from a point a bit to the west of Aker's anchorage projection there is a 79° angle between the east end of the headlands and Bolinas Point. The Farallons would be out of synch in this case, but the remark that they were "south" might have been in the order of a gross estimation.

This is an admittedly weak argument for the site being farther west. A more significant factor in supporting this idea, however, is the assumption that Aker makes about the wave refraction in the bay driving San Agustin aground to the east of its original anchorage (Aker 1965:56). A set of wave-refraction diagrams of Drakes Bay is offered in Technical Memorandum No. 14 of the U.S. Army Coastal Engineering Research Center (Cherry 1965:20). Assuming that there were swells from the west-northwest at 12-second periods, the projected push from the water should be directly onshore at the proposed site of the anchorage. With winds shifting to come out of the south, and probably the southeast, it would be logical to assume that a floating object would be pushed by combined wind and swell action either directly onshore or a considerable distance to the west.

Aker argues against the southeast wind by stating that "with a southeast wind, Cermeno could have gotten under way easily and tracked over to the southwest corner of the bay or out to sea...." It must be remembered, however, that Cermeno was not on board, nor is there any evidence that there were enough crew members left on board to haul anchor in a storm and sail the vessel out of danger. Also, a wind from the southwest should not have had significantly more fetch than the prevailing northwesterlies, although it is true that it would have been working with, rather than against, the swells. A wind out of the southeast, on the other hand would have been devastating, and although this is uncommon, they do occur and can be extremely dangerous to vessels moored away from the sheltered, southwest portion of the bay.

Conclusion

An analysis of the primary sources suggests that Aker's theory about the location of *San Agustin*'s anchorage is logically sound, but he may be slightly off in his projection of the probable wreck site. Members of this research team believe that the site is perhaps .5 to as much as 1.5 miles to the west. It is also apparent from the primary sources that any wreckage that might be associated with the possible earlier contact by Drake would probably not be confused with the material remains of *San Agustin*.

VI. LOSSES OF MAJOR VESSELS WITHIN THE DRAKES BAY SURVEY AREA

Introduction

The historical record indicates 15 major vessels were lost in Drakes Bay. The activity of these vessels at the time of their losses clearly indicates the variety of maritime trade and commerce on this coast. In some cases even the numbers and the types of ships wrecked in Drakes Bay offer insight into the specific significance of the area to certain trades.

Drakes Bay and the entire Point Reyes region served as an important sub-port for the active San Francisco Bay area. Hundreds of vessels sailed to and from San Francisco and passed Point Reyes, some lying to in Drakes Bay to provision or ride out a storm; other vessels connected Point Reyes and San Francisco, ferrying goods and supplies between both locales.

Maritime Development on the Pacific Coast, 1848-1940

With the discovery of gold in California in 1848, the primacy of San Francisco Bay as the principal port on the west coast of the United States was confirmed as hundreds of vessels of various sizes, rigs, and registries made their way to San Francisco as part of the "Gold Rush." Because of the protection of the great inland harbor, the bay proved to be a relatively safe haven for these vessels. Additionally, the great rivers that pierced California's interior drained into the bay, providing easy waterborne access to the Sierra foothills—and to the gold "diggins." In response to the Gold Rush traffic, San Francisco, formerly a small Anglo-Mexican hide-droghing port, became a major metropolis. As the principal port of the Gold Rush, San Francisco became the anchorage for hundreds of ships, and a way station for goods bound for the gold fields. Otherwise isolated from the rest of the world until the completion of the transcontinental railroad in 1869, the Pacific coast region depended on ships as the connecting links with civilization, bringing raw and manufactured goods, immigrants and capital.

San Francisco in particular depended on shipborne goods, as it grew rapidly in response to the Gold Rush. Lumber, bricks, food, machinery, and labor all came in the holds of vessels because San Francisco (and the rest of California) had no developed agricultural or industrial output. This situation continued for many years, and with the subsequent development of agriculture and industry on the Pacific coast, maritime trade and commerce continued. However, the role of shipping changed and no longer was the Pacific coast solely a consumer. Reciprocal trade burgeoned with the establishment of lumber mills, farms, factories and ranches.

One of the initial transportation trades to develop was an active coastal trade that resulted from the influx of goods from the eastern seaboard and Europe.

Lumber, hay, grain, dairy products, produce and meat were shipped up and down the coast, particularly to San Francisco. The rich groves of virgin redwood and Douglas fir along the coast sparked a busy lumber trade, supplying San Francisco and other growing urban areas on the west coast, until the trade eventually expanded to meet the lumber needs of the world. Throughout the active years of the lumber trade, ships were used for transport. The expense of constructing wagon roads and railroads to the forests was avoided by the cheaper and more expedient means of utilizing ships. At first, conditions were difficult. Ships built for other purposes were used, but eventually specialized coastal schooners were developed, propelled initially by sail and later by steam. These schooners proved to be the backbone of west coast shipping, many making the transition from lumber to general cargo. As the old wooden ships were retired or were sold abroad, new steel steamers were pressed into service by the same companies that had originally carried lumber. Hence, into the 1920s, 1930s, and 1940s, the new freighters carried on the tradition alongside a few hardy wooden veterans of days gone by.

In addition to the large workhorses of the sea, there were many other vessels. Square-rigged wooden, iron and steel sailing ships brought coal, machinery, and other goods from South America, Great Britain, Hawaii, the Far East and Europe. These vessels were gradually replaced by tramp steamers and freighters, many of which are still in service. The transportation of people by sea, still the best means of reaching California since its earliest settlement, peaked between 1848 and 1869, when more than 500,000 people were carried to San Francisco in the wooden steamers of the Pacific Mail Steamship Company and their competitors. As the need for shipborne transportation of freight declined, passenger service increased. Luxury service to major ports of the world has continued to the present from the major port of San Francisco.

Smaller craft also made important contributions. The bay and the waters of the Pacific were actively harvested for food, and large fleets of fishing vessels based first in San Francisco later became a frequent sight in the smaller ports of Monterey, Santa Cruz, Point Reyes and other coastal havens. From the junks of Chinese fisherman to the feluccas of Mediterranean immigrants and the Monterey trawlers, fishing boats changed with time and technology to remain important participants in the maritime industries of the San Francisco Bay-Point Reyes area.

Technology has brought new types of ships into service. The rich oil fields of the California coast spawned many oil companies. The development of processing facilities on San Francisco Bay has assured the harbor's continued use. Beginning in the 1920s oil, gasoline and kerosene tankers became increasingly more numerous on the Pacific coast as they made their way to or from San Francisco. As the need for larger cargoes increased, larger and more complex vessels were built, many in San Francisco, which boasted an active shipbuilding industry. Today, there are very few of the early tankers in service.

The maritime history of the San Francisco Bay region is diverse and in many ways unique. Molded and fitted to the particular needs and conditions inherent to the west coast, these ships served a critical role in the development of the region. They were constantly replaced despite a high rate of loss and accident on the rugged Pacific shoreline. Uncharted shoals and rocks, thick fogs, strong currents, and a host of pilot errors wrecked hundreds of ships on the coast of California, Oregon, and Washington. Nearly 300 wrecks clustered near the Golden Gate are an ironic indication of the importance of San Francisco as a port and harbor. These wrecks of this region comprise an important study collection for the maritime archeologist and historian, offering various ages, uses, methods of construction, and cargoes.

Vessel Classifications of Wrecks in Drakes Bay

Manila Trade and Voyages of Exploration (1556-1776): San Agustin (1595)

Hide and Tallow Trade (1826-1848): Ayacucho (1841)

West Coast Lumber Trade (1850-1936): Nahumkeag (1867), William Ackmann (1883), Pomo (1913), Hartwood (1929)

Coastal Trade (1848-1939): Annie (1871), Frances (1879), Valentine Alviso (1883), Lizzie Derby (1891), Annie E. Smale (1910), Colonel Baker (1913), Richfield (1930), Munleon (1931).

Discussion

San Agustin: The history, significance, and the wrecking of San Agustin (1595) are discussed elsewhere in this report and will not be discussed in detail in this section. Briefly, the vessel is the first well recorded shipwreck in California as well as the first known vessel to be wrecked in Drakes Bay. It is one of a small group of coastal exploration vessels utilized by the European nations, principally Spain, that operated on the Pacific between 1540 and 1776. San Agustin is also one of a slightly larger group of vessels that engaged in the Pacific extension of the Manila Trade, whereby the goods of the Far East and Asia were obtained and shipped to Spain. These ships also spread the Spanish Empire into the Philippines and in later years supplied the struggling colony of Alta California.

Ayacucho: Ayacucho (1841) is one of a small group of vessels that actively engaged in coastal trade along the California coast during the last years of Spanish rule (1776-1822) and the beginning of Mexican rule (1822-1846) in California.

Spanish law forbade any foreign trade in Alta California throughout Spain's tenure in the Americas, but during the last years of Spanish rule, waning authority and inadequate enforcement fostered an illicit, yet popular trade with visiting British, American and other foreign ships. After Mexico's successful revolution in 1821, Alta California became part of the new Mexican Empire (later Republic) in 1822. Trade regulations were relaxed, and the former smugglers became participants in what has been referred to as the "hide and tallow" trade. Trade goods from Europe, the United States and China were exchanged for rawhides and rendered tallow. California, basically an agrarian society, had little industry, principally cattle raising. The economy depended on the annual culling of the herd, the _rodeo_ and the _matanza_, to provide the rawhides and tallow sought by the visiting traders. Often these raw materials were taken to the United States or Europe, processed to make soap, candles, shoes and other leather goods, and then traded once again to the _Californios_ at inflationary rates for more hides and tallow. The hide and tallow trade is perhaps best illustrated in a reminiscent account by Prudencia Higuera:

> In 1840, when I was about twelve years old, I remember I saw the first American vessel that traded along our shores. One afternoon a horseman came to our ranch and told my father that a great ship, a ship with two sticks in the center, was about to enter our bay to buy hides and tallow.
>
> The next morning my father gave orders and my brothers with the peons, went on horseback to the smaller valleys to round up all the best cattle. They drove them to the beach, killed them there and salted the hides. They tried out the tallow in some iron kettles that my father had brought from one of the Vallejos, but as we did not have any barrels, we followed the common plan in those days. We cast the tallow in round piles about the size of a cheese, dug in the black adobe and plastered smooth with clay. Before the melted tallow was poured into the pit an oaken staff was thrust down in the center, so that by the two ends of it the heavy cake could be carried more easily. By working very hard we had a large number of hides and many pounds of tallow ready on the beach when the ship appeared far out in the bay and cast anchor near a point two or three miles away. The captain came soon to our landing with a small boat and two sailors one of whom was a Frenchman who knew Spanish very well, who acted as interpreter. The captain looked over the hides, and then asked my father to get into the boat and go to the vessel. Mother was afraid to let him go, as we all thought the Americans were not to be trusted unless we knew them very well. We feared they would carry my father off and keep him

> prisoner. Father said however, that it was all right; he went and putting on his best clothes, gay will silver braid, and we all cried and kissed him good-by, while mother clung about his neck and said we might never see him again. Then the captain told her: "If you are afraid, I will have the sailors take him to the vessel, while I stay here until he comes back. He ought to see all the goods I have, or he will not know what to buy."
>
> After a little my mother let him go with the captain, and we stood on the beach to see them off. Mother then came back, and had us kneel down and pray for father's safe return. Then we felt safe.
>
> He came back the next day, bringing four boat-loads of cloth, axes, shoes, fish-lines, and many new things. There were two grindstones, and some jewelry. My brother had traded some deer skins for a gun and four toothbrushes, the first ones I had ever seen...After the captain had carried all the hides and tallow to his ship he came back, very much pleased with his bargain, and gave my father, as a present, a little keg of what he called "Boston rum." We put it away for sick people.
>
> After the ship sailed my mother and sisters began to cut out new dresses, which the Indian women sewed. On one of mine mother put some big brass buttons about an inch across, with eagles on them. How proud I was. I used to rub them hard every day to make them shine, using the toothbrush and some of the pounded egg shell that my sisters and all the Spanish ladies kept in a box to put on their faces on great occasions.
>
> Then our neighbors who were ten or fifteen miles away came to see all the things we had bought (Ludwig 1928:145-146).

One participant in the trade aptly summed it up when he stated in his memoirs that it was "the laborious and not very agreeable work of hide-droghing... a lucrative trade..." (Thomes 1884:7). The trade particularly boomed after 1828; one historian has noted that:

> A great sailing-ship rush to the California coast followed. The stream from the Hawaiian entreport to the Spanish Main continued and increased. Another line pushed up the Pacific Coast from the young Hispanic American countries. Around the

> Horn from distant Boston came others, bound directly for the California market (Ogden 1941:91).

As the trade boomed, it performed several important functions. It created a lucrative business for many investors, particularly after 1841, when the faltering of the China trade during the Opium Wars and the decline of whaling in the Atlantic meant that new ventures and new markets were sought by Yankee capitalists. It provided needed manufactured and refined goods to the Californios. Many influential "foreigners" involved in the hide and tallow trade settled in California, including William E. P. Hartnell of Salinas (Dakin 1949), William Heath Davis of San Francisco (Davis 1967; Rolle 1956) and Alfred Robinson of Santa Barbara. Some foreigners active in the trade also secretly worked for the American acquisition of California. One in particular was the United States consul at Monterey, Thomas Oliver Larkin. The relaxation of trade restrictions and the influx of foreigners to California, both resulting from the hide and tallow trade, also hastened American acquisition of the Pacific coast:

> ...the area was even then in the throes of changing hands.... To the end New Englanders' lucrative activity was enhanced by both international and local conditions. Although the Spanish met the waves of American assault with recurrent efforts...they were fighting the inevitable...the vulnerability of the West Coast could not stand the intensity of the Yankee who was driven by necessity to establish his commerce in the Pacific (Coughlin 1967:116).

In addition, the hide and tallow trade provided the world with a classic of American literature, Richard Henry Dana's Two Years Before the Mast (1936).

Many vessels from scattered ports around the globe participated in the hide and tallow trade. Many hailed from Boston, while others sailed from the Hawaiian Islands (then known as the Sandwich Islands). Perhaps the most famous Hawaiian hide trader was Euphemia, owned by Paty and Davis, which ended her days in Gold Rush San Francisco, being used as the town jail and insane asylum (Delgado 1981b). Other vessels plied the coastal waters, hailing from Peru, Chile and Mexico. One of these vessels was Ayacucho. The ship first appears on the California coast under the command of Joseph Snook in 1830, according to a record of ships arriving at California ports from 1774 to 1847 that was compiled by James Alexander Forbes, Jr. and published by Davis in his memoirs (Davis 1967:265-281). In one of the strange coincidences of history, Snook became the grantee of the Mexican rancho Punta de los Reyes in 1838, after having settled in California. He built a small home for his majordomo or foreman near Drakes Estero, but apparently never lived on the ranch himself, quickly trading his property to Antonia Maria Osio for property in Southern California. Thus, Snook did not see his former command wrecked only a few miles from his foreman's home in 1841 (Toogood 1980: 41-43).

Ayacucho visited California in 1831, 1832, 1833 and 1834, while under the command of John Wilson. In 1834, while anchored off Santa Barbara, Ayacucho was observed by Dana, who described her as:

> ...a long, sharp brig of about three hundred tons, with raking masts and very square yards.... We afterwards learned that she was built at Guyaquil, and named the Ayacucho, after the place where the battle was fought that gave Peru her independence, and was now owned by a Scotchman named Wilson, who commanded her, and was engaged in the trade between Calloa and other parts of South America and California. She was a fast sailer, as we frequently afterwards saw, and had a crew of Sandwich Islanders on board (Dana 1936:58).

John Wilson, born in Scotland in 1795, became a resident of California in 1826, married Ramona Carrillo de Pacheco, and considered Santa Barbara his home. He owned Ayacucho between 1831 and 1837. He died in 1860 in California (Bancroft 1964:385).

Dana also recorded that Ayacucho's Sandwich-Islander crew worked hard at their task of loading the ship with hides:

> They ran the boat so far into the water that every large sea might float her, and two of them, with their trousers rolled up, stood by the bows, one on each side, keeping her in her right position. This was hard work; for besides the force they had to use on the boat, the large seas nearly took them off their legs. The others were running from the boat to the bank, upon which, out of reach of the water, was a pile of dry bullock's hides, doubled lengthwise in the middle, and nearly as stiff as boards. These they took on their heads, one or two at a time, and carried down to the boat, in which one of their number stowed them away (Dana 1936:61).

In 1836, Wilson sold Ayacucho to James McKinley, another Scot who had settled in California in 1824. It is assumed, but not definitely known, that McKinley sold Ayacucho to parties either in France or Mexico in 1840. Under Mexican registry and mastery, she continued in the hide and tallow trade until she was lost in 1841. A long-standing participant in the California trade, Ayacucho is mentioned often in correspondence, diaries, and account books of the time, particularly in the diary of Faxon Dean Atherton, an employee of the merchant Alpheus Thompson of Santa Barbara, who was an active participant in the hide and tallow trade (Nunis 1964).

Most contemporary accounts record that Ayacucho was a fast sailer. Dana saw her driving before the wind off the California coast during a storm and appreciatively described the sight:

> ...we saw the Ayacucho standing athwart our hawse sharp upon the wind, cutting through the head seas like a knife, with her raking masts and her sharp bows running up like the head of a greyhound. It was a beautiful sight. She was like a bird which had been frightened and had spread her wings in flight (Dana 1936:65).

The lack of documentation and considerable confusion in available records indicate there could have been two vessels with the same name operating on the California coast: Ayacucho owned and skippered by Wilson and McKinley and described by Dana is cited by Forbes as an English brig. Dana and Atherton also describe Ayacucho as a brig. The vessel lost at Drakes Bay is described as a schooner. Eugene Duflot du Mofras, a French visitor to California in 1841, stated that the vessel lost that year was French and belonged to the Bordeaux firm of Bizat and Roussell; Ayacucho was commanded by a Mexican, though, named Jose Blanca, and the cargo was owned by French-born Mexican citizen Joses Yves Limantour. In the midst of this confusion, one possible explanation could be the Guyaquil-built Ayacucho, after it was owned and operated by Wilson and McKinley between 1830 and 1840, was sold to Bizat and Roussell for the California trade. Perhaps Limantour was an agent or associate of Bizat and Roussell operating in Mexico; this would explain the ship's Mexican master and would preclude a voyage to and from France for Ayacucho. The authors believe there was but one Ayacucho, and that after a long and productive life on the California coast engaging in the hide and tallow trade she was lost in Drakes Bay by new and inexperienced owners. Clearly, additional research is needed on the ship's history. Mexico, where the Limantour family still resides, would be the likely starting point.

The paucity of documentation of Ayacucho's career is most evident in accounts of her loss. The closest thing to a contemporary account (the wreck was mentioned as having occurred in some correspondence of the time) is a reminiscence by Captain John Paty, who assisted in the salvage of Ayacucho's cargo after she went aground and was lost at Drakes Bay on October 27, 1841. In 1859 Paty recalled that:

> Limantour had a little brigantine called Ayacucho, Blanco, Capt. It appears that he disagreed with Blanco, and discharged him at Monterey and got a ranchero for a sailing or "paper captain," and concluded to take the brig to San Francisco himself. He made a grand mistake, however. Report says that he ran for Point Reyes, with fine, clear weather, with the Farallones bearing nearly south, when they ought to

> have been nearly west. When nearing the little harbor of Point Reyes, some one observed to him that there were breakers ahead. He replied: "Never mind; they told me I should have to pass through breakers to get into San Francisco," —— and continued on until he found his vessel aground on the bar. It is asserted that he got no anchor out in order to get his vessel off, but got his boat out and went around Point Reyes, looking for San Francisco. A few days afterwards a south-easter came on, and his vessel bilged. He had a cargo on board valued at $65,000, of which he saved about three fourths, got it landed on the beach, and after remaining ten or twelve days, and not knowing where he was, was discovered by an Indian, who showed him the way to San Francisco (Paty 1859:296).

Davis offers some explanation as to Limantour's discharge of Captain Blanco (or Blanca), indicating that Limantour wished to avoid custom duties by landing at San Francisco rather than at the usual and legal port of entry at Monterey. Limantour may have been cleverer than he appears in the above account. Davis in his memoirs also stated that Ayacucho's cargo consisted of "silks, brandy and other costly goods" (Davis 1967:109). The salvaged goods found a ready market, according to Davis, since:

> The muslins and calicoes were of fine texture and fast colors and sold readily to the California women, who came from their ranchos purposely to obtain the choice French fabrics. The silks of this cargo were French and Italian, of the finest quality.... Silk was largely used by the California ladies, the wealthier class dressing in that material (Davis 1967:110).

As for Ayacucho, Davis recorded that "the vessel subsequently became a total wreck and went to pieces where she struck" (Davis 1967:110).

Thus Drakes Bay claimed its second recorded victim, and another vessel was added to the archeological record of Pacific coast shipping, trade and commerce.

Nahumkeag: When gold was discovered in California in 1848, the resultant news explosion throughout the civilized world drew hundreds of ships of every size, rig and registry bound for San Francisco, the gateway to the gold fields (Roske 1963). In 1849, 777 ships sailed for San Francisco, forming the crest of a massive rush for fortune, which has been termed the greatest mass migration of mankind since the Crusades. These ships, dubbed the "California fleet," included:

> sailing vessels, whalers, cargo boats hastily fitted with bunks as their space justified. Condemned hulks were pressed into service and lake boats, built for sheltered waters, were sent forth to battle Atlantic gales...(Bari 1931:xiii).

According to John B. Goodman, leading historian of the Gold Rush migration by sea, Nahumkeag was built in Pittston, Maine, in 1846, with a length of 110 feet, beam 24 feet 6 inches, depth of hold 11 feet, and 290 80/95 registered tons. She was built with one deck, three masts (rigged as a bark), a square stern and a billet head. Nahumkeag's early career is unknown. On March 1, 1849, she sailed from Providence, Rhode Island, carrying 30 passengers, all members of the Roger Williams Mining Association. She arrived in San Francisco on November 15, 1849, after an uneventful passage. In San Francisco, Nahumkeag faced an uncertain fate. Hundreds of vessels, abandoned by officers and crew, already lay rotting on the waterfront (Delgado 1979). Many never sailed again, being converted into buildings, purposely scuttled, or dismantled for their metal (Delgado 1981a). Nahumkeag, however, escaped this fate, entering into the transatlantic trade, carrying needed supplies to the gold rush market of San Francisco. Created almost overnight as a result of the massive influx of people, San Francisco—without the benefit of established industry, manufacturing, or agriculture—had become a major urban center and central shipping point for the gold mines. As a result, the city and the gold mines were almost entirely dependent upon shipborne goods. Nahumkeag, having fulfilled one important task in bringing gold rush immigrants to California, now accomplished another in providing the region with the means for survival. On one voyage from Manila, Nahumkeag is listed as bringing "292 jars eggs, 30 cases cigars, sugar, coffee, and cordage" as well as two passengers (Rasmussen 1966:73). After 1852, with little exception, she sailed on the coast bringing lumber, passengers, supplies such as "300 hogs, 1400 chickens, 100 sacks of flour, 10 boxes salmon, and 4 lbs. of butter" (Rasmussen 1970:109). Her most frequent cargo, however, was lumber.

The constant growth of San Francisco and the need for additional buildings, especially after six major fires swept the city, created an incessant demand for lumber. As the timber groves in and around San Francisco Bay were exhausted, virgin stands of redwood on the northwest coast were tapped. Available ships were pressed into service to carry lumber, and since Nahumkeag operated primarily between San Francisco and northwest ports, she soon became one of the first vessels to engage in the lucrative and long-lasting west coast lumber trade. Additionally, Nahumkeag carried passengers and cargo between San Francisco and northwest ports such as Portland and Seattle. By 1860, "the Nahumkeag became a household name on the northwest coast" (Goodman, n.d.:6). Hence, her significance also derived from providing a socioeconomic tie between San Francisco—the principal port on the west coast—and many smaller, more isolated settlements along the coast. Nahumkeag played an incidental role in

the success and development of Seattle, principal port of the Northwest, which, like San Francisco, depended upon seaborne transportation (Sale 1976).

Nahumkeag also played an incidental part in another significant aspect of west coast maritime history. By 1857, the boom of the California Gold Rush was declining. In 1857, an impending national financial "panic" had worried San Francisco bankers and businessmen. In October, 1857, banker William Tecumseh Sherman (later a Civil War general) noted that "all hell has broken loose...there is a run on every bank in the city, many of which have gone in. I see no reason why all must not succumb. Of all excitement before, this exceeds by ten fold" (Clarke 1969:330). The inflated Gold Rush market having gone bust, and mining having passed out of the hands of individual prospectors and into the hands of large conglomerates and companies, inspired a minor Gold Rush in 1858, in response to news of a gold strike on the banks of British Columbia's Fraser River. As thousands poured north, Nahumkeag joined in the rush, transporting 60 passengers to Victoria, British Columbia, on July 3, 1858 (Goodman, n.d. 5). In addition to Anglos hoping to make a quick fortune, Nahumkeag may have also carried some of California's departing black citizens, who were fleeing the United States and its racist laws and policies. Enticed to British Columbia by Governor James Douglas's promises of equality, hundreds of prominent California blacks, including Archy Lee, defendant in California's last Fugitive Slave Act case, departed San Francisco never to return (Edwards 1977; Lapp 1977). These black pioneers played an important role in the history of California, as well as in Canadian history. If Nahumkeag did indeed transport some of these people, her significance begins to assume a national character. Additional research into the vessel's history is desirable.

Nahumkeag was lost in Drakes Bay on April 13, 1867, during a severe storm that wrecked several other ships on the coast, including the schooners Mendocino and Josephine Wilcutt at Mendocino, and Sine Johnson at Novarro. Other ships were damaged by the storm, and as damage reports reached San Francisco, it came as no surprise to read the headlines: "ANOTHER WRECKED VESSEL." The San Francisco Daily Evening Bulletin of April 27, 1867, reported that Nuhumkeag, loaded with "a cargo of lumber" and a few passengers had gone ashore at Drakes Bay during the heavy blow. According to Charles Westmoreland, one of the passengers, the storm, which began after the ship departed Humboldt Bay, increased in violence and soon Nahumkeag...

> ...encountered unusually rough weather and seas, which continued to grow in violence as they made Point Reyes, when the Captain decided to run into Drakes Bay for shelter. They cast anchor about 6 o'clock on Thursday evening, but the fury of the gale continued and parted the heavy chain cable. The small anchor and kedge were then dropped, but proving insufficient to hold the vessel, she commenced to drag, and finally struck about 2 1/2 o'clock Friday morning, the sea

> breaking over her. In this situation the vessel, crew and passengers remained until past seven o'clock, when they succeeded in getting a line ashore, by which all were released from their perilous position. No personal property of any description was saved from the vessel, which is a total wreck.

Though still seaworthy and able to carry on in the trade, Nahumkeag had, by the time of her loss, outlived her usefulness. Conditions on the Pacific coast, where most harbors were narrow rock-infested coves known as "dog-holes," meant that specialized ships, small, inexpensive to build (and hence less of a financial disaster when lost) and of the highly maneuverable schooner-rig were needed for the lumber trade. Such ships were soon built and became known as west coast lumber schooners. Consequently, older vessels drafted into the lumber trade, such as Nahumkeag, became obsolete.

William Ackmann: As mentioned above, the influx of settlers and the resultant spread of urbanization on the Pacific coast demanded a ready supply of lumber for construction. As new towns arose, and as additional construction in urban centers continued, more lumber was required. During the Gold Rush, lumber was imported from distant ports or logged from groves around San Francisco Bay. The local groves soon thinned, however, and the timber supply that had provided the San Francisco Bay region with lumber since 1776 was soon exhausted (Brown 1966; Burgess 1962). By 1860, the substantial redwood groves of the East Bay were gone (Burgess 1951). Soon new groves were sought to supply the expanding needs of the region. The development of logging camps and mills on the rugged California and Oregon coasts amid large stands of virgin redwood solved the need for additional lumber. These groves had been first logged in the mid-1850s, and by the mid-1860s many companies and mills were in operation, giving rise to small towns. Since no railroads and few wagon roads existed to bring the finished lumber to market, the sea became the major highway of the Pacific coast lumber trade.

There were inherent problems in using the Pacific for transportation. Coastal fogs, strong winds, hidden rocks, uncharted shoals and swift currents plagued the mariner. Most lumber ports were harbors where a ship barely fit, anchored close to the rocky shore near imminent destruction, and forced to load with wire cables or chutes:

> The lumber is sent down the chute, near the end of which a man operates a brake to check the force with which the lumber descends. The seamen stand ready to catch the lumber as it leaves the chute. As each man gets a piece of timber he runs with it, lays it down exactly where it belongs, and returns to the chute...(Captain Carl Rydell as quoted in Kortum and Olmsted 1971:45).

The dangerous conditions of the trade soon gave rise to a specialized fleet of wooden lumber schooners, built of indigenous Douglas fir with long, wide holds and schooner-rigged to tack in and out of the narrow harbors along the rock strewn California and Oregon coast. More than 400 west coast lumber schooners were built, but today only two survive: Wawona, moored on Puget Sound, and C. A. Thayer, a National Historic Landmark vessel moored on the San Francisco waterfront as part of the National Maritime Museum. During the same time the sailing schooners were performing yeoman service on the coast in the lumber trade, the difficult conditions gave rise to steam-propelled vessels:

> The paramount advantages inherent in operating steam ships, rather than sailing vessels, into these dangerous inlets led to the introduction of the "steam schooner" in this trade at a time when sail was yet undisputed on the world's bulk trade routes. (San Francisco Maritime Museum 1960).

The first "steam schooners" operated on the west coast lumber trade were auxiliary steamers, powered by steam engines but employing sail when it proved advantageous. Rather than being intentionally constructed as a steamship, many of the first steam schooners were sailing vessels whose decks had been turned up, engines and boilers stowed in the hold, and small cabins built on the afterdeck from which the stack rose. After the first conversions done around 1880 had proven successful, new vessels were built specifically to carry engines. One of those vessels was the auxiliary steamer William Ackmann, built in San Francisco, in 1881 by Ludwig Mortenson. According to Mortenson, he was standing on the corner of Market and Speark streets in San Francisco when a stranger casually asked him:

> Can you build an auxiliary steam schooner that can carry 200,000 feet of lumber on a seven foot draft, dimensions 100 foot on keel, 28 feet beam and 6 feet depth of hold? (Daily Alta California, April 11, 1883).

Mortenson asked the stranger to call at his home on the morrow for an answer. Mortenson and the stranger, who gave his name as M. S. Creagh, met and there Creagh was assured that the ship could be built. There was some disagreement, however. Mortenson noted that:

> After making my draft and model, the latter being shown to some of the water-front sharps, they decided that the vessel could not be built on the lines. However, there were a few who believed in Creagh's and my theory and subscribed the necessary capital to start the vessel, with the Fulton Iron Works among the rest, they having a belief that an

> introduction of such a craft would pay the interested parties....(Daily Alta California, April 11, 1883).

William Ackmann was launched in late 1881. As one of the first vessels on the west coast to be planned and built as a steamer from the keel up, she was a harbinger of major change in the lumber trade. In addition to being one of the first steam schooners actively employed in a trade that would, by 1900, almost exclusively employ steam-propelled vessels, William Ackmann and her sisters also signalled a major sociological change in the lumber trade:

> There was little ceremony when the "monkey-wrench" seamen came aboard; the sailors feared and hated the shoreside aristocrats of steam. Many a broken skull resulted from fights that flared up when members of the black-gang could no longer stand the slurs cast in their direction by the sailors.... Bad blood between deck and engine-room hands led operators to alter accommodations, so that the black-gang lived in the portside of the forecastle and the sailors on the starboard side; it was the same with the deck officers and the engineers in the quarter-deck--engineers on the port, deck officers sacked on the starboard side.... Today separate quarters are maintained for deck and engine-room departments and, although they can and do get along, the same jealousy prevails (McNairn and MacMullen 1945:17).

William Ackmann had a short but eventful career. In her 18 months of active service she was the first vessel to use the newly constructed chute at Kibesillah (near Westport, California): "the honor of naming a new landing is given to the Captain who first enters a shipping place.... Captain Olsen of the Ackmann availed himself of the opportunity and called it `Ackmann's Landing' (Mendocino Beacon, June 24, 1882). She also demonstrated the benefits of steam propulsion, departing San Francisco at 4 p.m. on July 17, 1882, arriving at Ackmann's Landing, discharging her freight, loading 6,000 ties, and departing for San Francisco on Thursday, July 20, 1882, thereby beating the record of every other vessel engaged in the coast trade. The Mendocino Beacon of July 29, 1882, acknowledged the role that Ackmann's auxiliary steam power had played and claimed that the "increased expense is more than counter balanced by the saving of time." On April 7, 1883, Ackmann, loaded with posts and bark, was plying the coast on her way from Westport to San Francisco. A thick fog covered the water and Ackmann was running close to shore, feeling her way along the coast. Despite the warnings of the powerful beams from Point Reyes Light and the mighty five-second blast that sounded every 70 seconds from the light's steam fog signal, Ackmann was caught in the breakers just north of the light was tossed ashore at the very westerly end of Point Reyes Beach. Captain Olsen and Ackmann's eight-man crew managed to reach shore safely. Their fire on the beach and signals from a hand lantern attracted the attention of Lighthouse Keeper

E.G. Chamberlain, who rescued the men from a cold night on Point Reyes' sands. The following morning the steamer Queen of the Pacific passed the wreck site. According to Captain Alexander of Queen, Ackmann lay broadside to the beach, high and dry and motionless. Because of her position, it was impossible to save the ship. At the time of loss, William Ackmann, like so many other vessels of the time, was owned by more than one person, and the loss affected more than one household. Valued at $24,000, Ackmann was owned by Thomas Pollard, A. McPherson and William Ackmann, who possessed five-eighths of the ship. Captain Olsen owned the remaining three-eighths. All interests except Olsen's were fully insured.

In her brief 18-month career, William Ackmann had demonstrated the feasibility of the steam schooner. Indeed, soon after her loss, Ackmann's builder, Ludwig Mortenson, announced that "he is ready to build a similiar steam schooner to some other party's order" (Alta, April 11, 1883). Many steam schooners followed in her wake, with more than 220 eventually doing duty as the workhorses of the lumber trade, carrying the bulk of the trade for over 50 years.

Pomo: By the late 19th century, steam schooners had all but replaced the sailing schooners working the Pacific coast lumber trade. Two basic types had emerged: the "single-ender" that had the engines aft and the main hatch forward; and the "double-ender" with the engine and pilothouse amidships, and holds fore and aft. S.S. Pomo, built by Hans Bendixson of Fairhaven (a small port on Humboldt Bay), and launched in 1903, was a single-ender of 368 tons (Plate 1). Pomo served on the coast in the lumber trade for 10 years before meeting her end in Drakes Bay on January 2, 1914.

Pomo sailed from Albion on the Mendocino coast with a cargo of rare blue-butt redwood on December 30, 1913. In addition to 15 crew members she also carried two passengers. Just one day out, Pomo encountered heavy seas as a southeast gale roared in. After a heavy pounding, Pomo's seams opened to the seas. After a three-hour battle against the rising water, the black gang was forced to draw the fires as the sea reached the engine room. As the engines stopped, the ship listed heavily and mountainous seas washed away the deck load and portions of Pomo's superstructure. Wallowing in the trough of the sea about 25 miles northwest of Point Reyes, Pomo was in danger of foundering. Captain Lilleland ordered that the ship's distress signal rockets be fired. Nearby, the steamer Adeline Smith, spotting Pomo's rockets, hurried to the rescue. Heaving to as close to Pomo as he dared, Captain Olsen of Smith prepared to take the crew and passengers of Pomo off the doomed ship. Chief Officer Peterson of Smith and a hand-picked crew launched a lifeboat, and despite the heavy seas managed to rescue every person aboard Pomo. A tow-line was secured to Pomo. Smith, struggling against the gale, began to steam for San Francisco.

Plate 1. The steam schooner Pomo moored offshore on the California coast in Mendocino County, date unknown. Pomo, an excellent example of the "single-ended" wooden steam schooners, is shown here in her element: anchored close to shore (note the twin mooring lines at bow and stern) close to the rocks and ready to load her timber cargo. Photographer Unknown, National Maritime Museum, San Francisco.

As Pomo filled and became waterlogged, Smith's forward struggle against the heavy sea slowed to a snail's pace. Progress was further hampered when Pomo capsized. Thirty-six hours after she had taken the distressed Pomo in tow, Adeline Smith had gone approximately 30 miles to reach Drakes Bay. On January 2, 1914, the United States Life-Saving Service's wreck report noted that Smith was in the Bay with Pomo in tow, and Pomo was "submerged and bottom up, with only a very small portion of the hull showing above the water." Thinking that Smith might need assistance, the U.S.L.S.S. crew began to pull for the two steamers, but before they could reach them, Smith had raised anchor and started again for San Francisco. Twice the hawsers parted and were resecured, but 12 hours after departing Drakes Bay the goal was finally near. Then, just off the San Francisco lightship, the hawser parted for the third and last time. Captain Olsen and his crew, exhausted after a 48-hour battle, decided to abandon Pomo. Drifting northward, Pomo soon afterwards washed ashore near the entrance to Drakes Estero, a total loss.

The storm that had claimed Pomo had been monumentally ferocious. The captain of J. B. Stetson, which had lost a 200,000-board-foot deck load to the storm during a six-day passage from Grays Harbor to San Francisco, described it as "one of the worse storms in his experience." The San Francisco Examiner of January 13, 1914, reported that the bars of all coastal harbors had been "breaking badly," that 12 vessels were bar-bound inside the Columbia River bar at Astoria, and that winds at San Francisco's North Head had been clocked at 65 miles per hour on January 2. Under such conditions Captain Olsen's daring attempt to salvage Pomo can only be viewed as amazing (another later salvage attempt can be viewed in Plates 2 and 3).

On January 4, 1914, the San Francisco Examiner reported that Swayne and Hoyt, owners of the ill-fated ship, were considering salvaging Pomo's machinery and hull cargo of redwood, as soon as the storm subsided. In order to salvage the machinery and the cargo, Pomo would need to be righted: "as the Pomo is one of the small wooden obsolete ships this can be accomplished without difficulty."

By 1914, the small rugged steam schooners, which had carried the timber needed by Pacific coast ports since 1883, were considered obsolete and were being replaced by larger, more modern vessels, notably steel freighters. In light of this, the lack of a comprehensive salvage effort seems understandable, since the engine of Pomo visibly marks her grave (Plate 4), yet she was not salvaged. According to one local historian, some salvage was undertaken by nearby rancher Henry Claussen and some of his milkhands, who rowed out to the stranded hulk, where they chiseled and hacksawed off brass valves and chunks, some weighing as much as 150 pounds (Mason 1970:132). A remarkable series of contemporary photographs taken by Clara Marshall recording the disintegration of Pomo were located in the National Maritime Museum in San Francisco and represented in Plates 5-9. These photographs and continued study of the wreck site offer a

Plate 2. Iaqua attempting to salvage Pomo on January 2, 1914. Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 3. Another view of the Iaqua attempting to salvage Pomo. Note the serious sag in Pomo's hull and the skewed angle of her masts, both indications of serious damage. Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 4. Triple-expansion engine of Pomo in the surf lines after the heavy winter storms of 1982 (NPS photo).

Plate 5. Pomo ashore and righted, February 1914. After drifting onto Drakes Bay's shores, capsized and awash, Pomo was re-righted by the salvage ship Iaqua. Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 6. Deck view looking forward on S.S. Pomo. Pomo's engine can be seen in the foreground. The boiler can also be seen. The forecastle deck and a small portion of the starboard hull, shown in the photograph, were observed on the beach in 1983 (Appexdix II). Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 7. Deck view looking aft on S.S. Pomo, 1914. The missing sterncastle, the ship's bulwarks, can be seen. Boiler is visible in midship hatch, cargo of redwood visible in the forward hatch. Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 8. Pomo ashore and in the process of breaking up, February 1914. After being abandoned by Iaqua, Pomo drifted in onto the beach, broadsided, and began to disintegrate in the breakers. Photograph by Clara Marshall, National Maritime Museum, San Francisco.

Plate 9. View of Pomo on the beach at Drakes Bay. National Maritime Museum photograph.

unique insight into wreck formation processes for wooden-hulled vessels in the survey area.

The triple-expansion engine of Pomo remained on the site of the wreck long after the hull separated. Exposed and protruding from the water in 1982 and 1983, the engine may have at times been covered by sand. A succession of severe winter storms in 1982-83 stripped several feet of sand from beaches along the California coastline, perhaps exposing formerly covered machinery. Structural remains from the vessel have been noted, particularly in the early 1960s (Aker 1965:36). Extreme beach erosion in early 1983 re-exposed at least eight major portions of wreckage from Pomo, notably sections of the starboard side of the ship, a small section of the port side and the aftercabin bulkhead, portions of the deck and hatch, and the deck forming the roof of the aftercabin (Appendix II).

Hartwood: Hartwood, a 200-foot, 946-ton "double-ended" steam schooner, was built in Hoquiam, Washington, by the Matthews Shipbuilding Company for the Hart-Wood Lumber Company of San Francisco (Plate 10). Launched in 1916, Hartwood represented one of the later stages in the development of the Pacific coast lumber schooner. "Double-enders" were built to replace the older "single-ended" steam schooners (such as S.S. Pomo, built in 1903, and wrecked in Drakes Bay in 1913), and were primarily used from 1916 to 1923, when most of the wooden-hulled steamers had been replaced by steel-hulled vessels such as Munleon (wrecked near Hartwood's grave in 1931, see below). The term "double-ender" referred to the fact that these steam schooners had their machinery housed amidships, with cargo spaces fore and aft; "single-enders" had their machinery housed aft with cargo spaces forward. Characteristically, both types of steam schooner had high forecastles to protect their deck cargo and high sterncastles to keep out a following sea. These additional spaces on deck added to below-deck cargo-carrying capacity. Fine lines below the water line kept the ships knifing through the water, reducing the problems of cavitation when running north along the coast in heavy seas without a cargo. The hulls were also deep and beamy to allow for the maximum stowage of their lumber cargoes. Hartwood's capacity (including deck load) was 1,250,000 board feet. To load the ship, two cargo gears consisting of twin booms, each mounted on a mast (one on the foremast, one on the main) with falls leading to two steam-powered friction winches were employed. The maximum weight each gear could hold was 5 tons; the averge load was 3 tons. The ship was capable of loading and off-loading without shoreside cranes or support. The booms ranged in length from 60 to 75 feet and could easily swing the load clear of the vessel's sides. In addition, the winches were located on raised platforms, which gave the operator a clear field of vision and protected the machinery.

Operating on the Pacific coast, Hartwood represented the last stage of wooden-hulled lumber carriers. She was continuing a tradition that had begun with vessels of all types being converted for the lumber trade (such as

Plate 10. The steam schooner Hartwood moored in an unknown port, date unknown. An excellent example of the "double-ended" wooden hulled steam schooner, the design of Hartwood departs form that of the earlier Pomo. Note the cabins are located amidships, over the machinery, with cargo spaces fore and aft. National Maritime Museum, San Francisco.

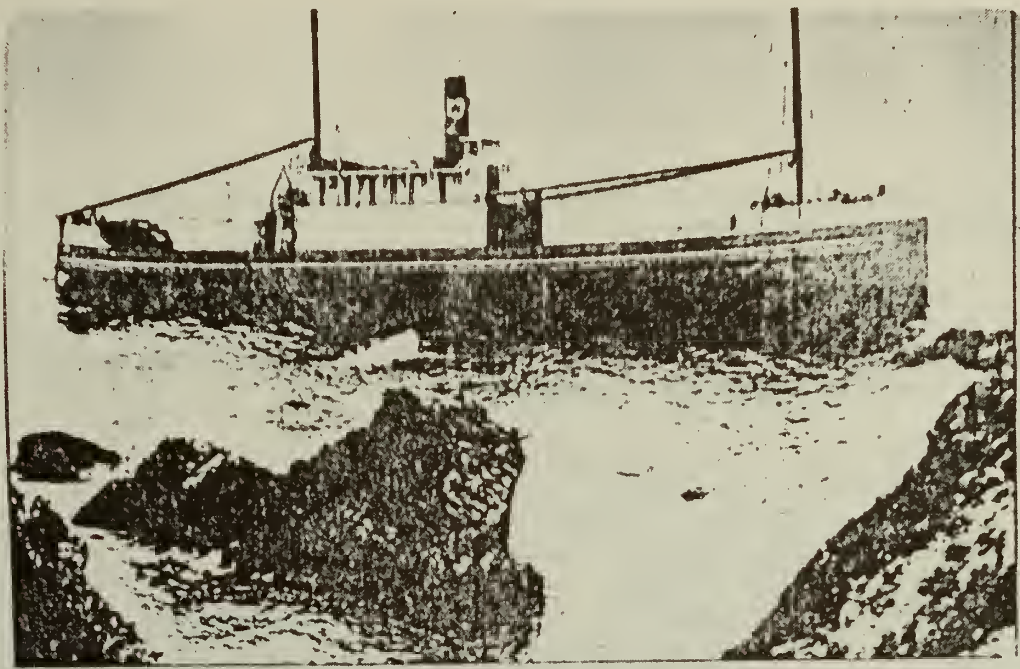
Nahumkeag). A tradition that had lasted through the development of specialized craft, both sail and steam, like the sailing schooner Annie Smale, the auxiliary steamer William Ackmann, and the single-ended steam schooner Pomo. The tradition would last after Pomo and Hartwood's sisters had gone to their graves through the medium of larger steel freighters.

Hartwood's career in the Pacific coast lumber trade spanned the years 1916 to 1929. On June 27, 1929, the ship left San Francisco at 5 p.m. with 26 persons and a mixed cargo of wire cable, steel pipe and sugar. She was bound for South Bend, Oregon. Passing through the Golden Gate, Hartwood experienced heavy seas, a stiff northeast wind, and a thick fog. Four hours later, around 9 p.m., Hartwood ran aground (Plates 11-12). According to crew members, the impact was described as being "no harder than that of heavy sea" while groping her way through the fog at 8 knots. Her SOS was received in Daly City by the MacKay Radio and Telegraph station at 9:18 p.m. Captain Enstrom, upon inspecting the ship's hold, ordered the crew to abandon ship as the steamer was leaking badly. Two boats were launched. Thirteen people, including the captain's wife, 5-year-old son, and the 7-year-old son of the first mate, slid down the falls into the boats. Heavy seas prevented the launching of the smaller workboat, leaving 13 men stranded on the ship.

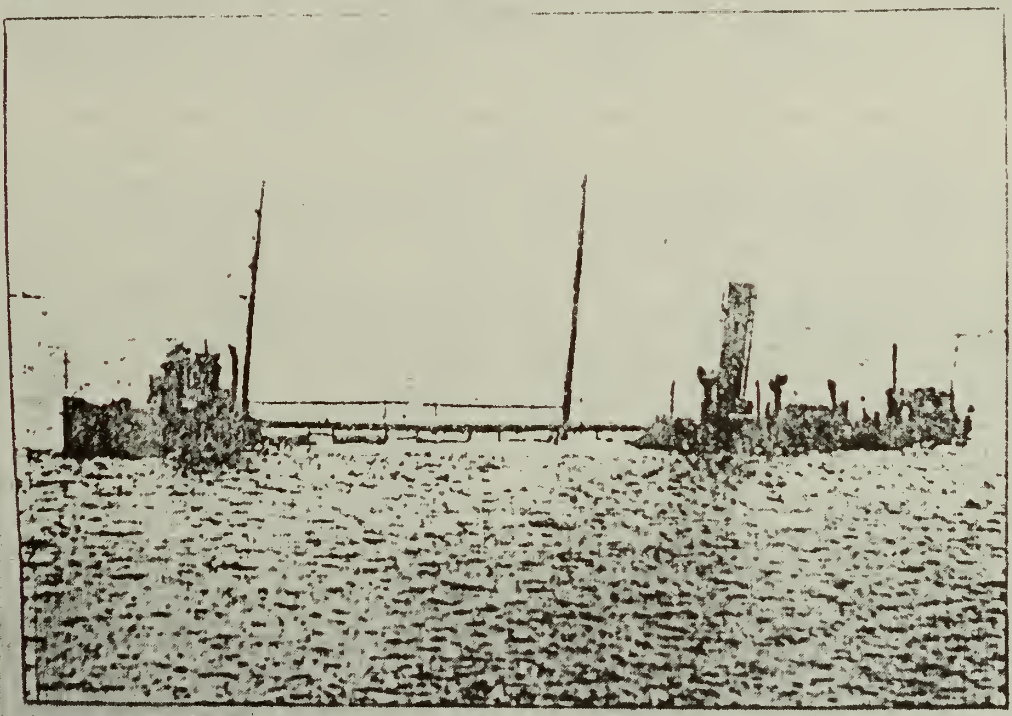
The two lifeboats were located by the crew of the United States Life-Saving Service station at Point Reyes. The occupants were taken to the station while the life-saving crew rigged a breeches buoy between Hartwood and the rocky Point Reyes Headlands. As the cable alternately sagged and snapped taut with each roll of the ship, three men were hauled to safety. The breeches buoy was abandoned after the third came ashore, however, as the increasing swell was cracking the cable like a whip. By running their motor launch close to Hartwood, though, the crew was able to pass a line to the ship. Most of the men crossed over the line, hand over hand, to reach the launch. Meanwhile, the crew on shore raised the breeches buoy cable and pulled the last two Hartwood crew members ashore. In the finest tradition of the sea, Captain Enstrom was the last to leave his ship.

Two conflicting explanations were given for the mishap. The quartermaster, who was at the wheel at the time of the loss, claimed that the captain and the mate had mistaken the light on a buoy off the tip of the Point Reyes headlands for the Point Reyes Lighthouse in the "pea soup" fog. Thinking that they had cleared the headlands, the captain ordered the ship's course changed to a northeast bearing, and within half an hour the ship had run aground on the rocks. Captain Enstrom denied the charge, stating that he had not heard the fog horns for either Duxbury Reef or Point Reyes and hence could not fix his position. He claimed that the steel cargo had affected his compass, causing him to navigate Hartwood two miles closer to the coast than was his custom. In fairness to the captain, it must be noted that he was a veteran coastal sailor,

Plate 11. Hartwood ashore at Point Reyes, June 27, 1929. National Maritime Museum, San Francisco.



On Thursday, June 27, 1929, at 9 p.m., the steamship Hartwood, valued at $80,000, went aground one-and-a-half miles east of Point Reyes and became a total loss.



At noon on Thursday, May 8, 1930, the Richfield, a 250-ton tanker on a trip from San Francisco to Portland with 25,000 barrels of high test gasoline, went aground about 500 yards offshore and to the south of Chimney Rock.

Plate 12. Contemporary newspaper accounts of the wrecks of Hartwood and Richfield.

having made the run some 200 times; he had commanded Hartwood for four years and this was his first accident.

The ship, caught in a tight grip between the rocks, soon flooded, but she was trapped on the rocks and did not sink. Later storms broke her apart after some light salvage had occurred. The wreckage of Hartwood was located in 1982, during the submerged cultural resource survey.

Shasta: The steam schooner Shasta was built in Hoquiam, Washington, in 1908 by the Matthews Shipbuilding Company. Hoquiam, a lumber port located at the mouth of the Hoquiam River on the shores of Grays Harbor on northern Washington's coast, was one of many towns established in the midst of the forests and logging camps that produced ships for the west coast lumber trade. As built, Shasta was a typical double-ended west coast steam schooner, with the characteristic high forecastle and poop, and with the machinery and superstructure midships (Plate 13). Registered in 1909, officially No. 105041, Shasta was 192.3 feet long, with a beam of 41 feet, a depth of hold of 14 feet and a gross of 878 tons and net of 517. Shasta was a screw-driven vessel powered by a 12-1/2 by 20-1/2 by 24 triple-expansion steam engine manufactured by the Union Iron Works of San Francisco. The engine was capable of developing 475 indicated horsepower. Shasta had one oil-fired Scotch marine boiler measuring 10 feet 10 inches by 12 feet. The vessel was rigged with two masts to support the booms used to load lumber cargoes, one fore and one immediately aft of the superstructure. Shasta carried 910,000 board feet of lumber, 600,000 feet were stowed on deck, and 310,000 were stowed below. The winches for each mast were different, one set was 8 by 8 feet friction winches, the other 9 by 9 feet geared. The ship normally carried a crew of 19. Little is known of her early career. A more detailed history might be produced from a careful reading of the San Francisco newspapers of the period. She was apparently owned by the same firm, the E.K. Wood Lumber Co. of San Francisco, for most of her life. Only two of her master's names are known: Captains Sorenson (in command in 1924) and Tho (in command in 1929 and 1930).

Unlike her earlier counterparts, the steam schooners wrecked in the midst of their careers in the lumber trade (William H. Ackmann, Pomo and Hartwood) in the survey area, Shasta was lost after her lumber career had ended. E.K. Wood sold Shasta in 1933 to a new owner who operated the ship on San Francisco Bay until 1936 when she was laid up on "Rotten Row" in Oakland Creek. A victim of changing times, Shasta gave way to new, more efficient steel-hulled lumber-carrying ships that had begun entering the trade and challenging the older, smaller wooden-hulled steam schooners that had been operating on the coast since the 1880s. Oakland Creek was the last mooring of many schooners:

> In this backwater of San Francisco Bay lies the largest group of old, weather-beaten, wooden steam schooners. Their once white superstructures are gray and chalky, bared of paint in

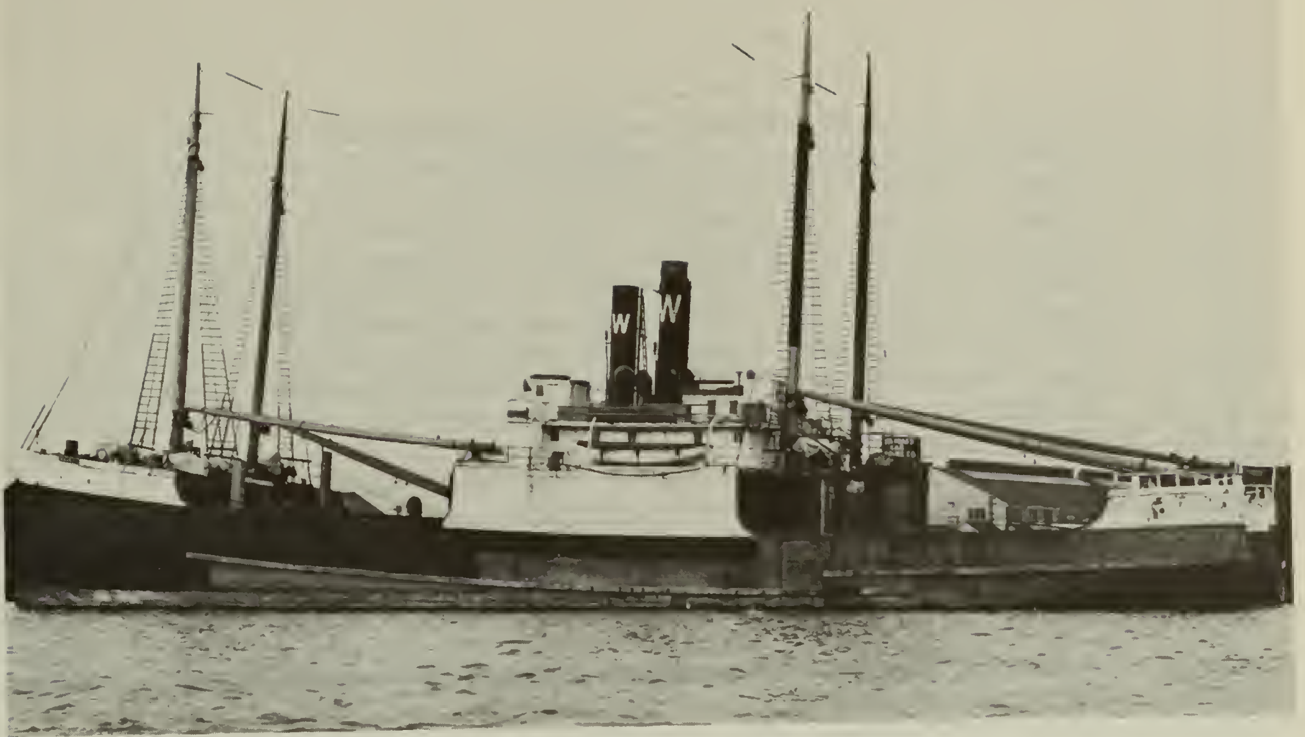


Plate 13. <u>Shasta</u> docked at Oakland, California, ca. 1936.

Plate 14. <u>Shasta</u> hard agound, Drakes Bay, February 23, 1939.

> many spots by the winds. Rotted rope-falls hang from davits; rotted canvas exposes the once-buoyant cork of life-rings...A ghostly silence surrounds the old ships. Empty decks and vacant cabins lend eerieness to this marine graveyard. Missing is the noisy clatter of cargo winches, long frozen by rust...Shrouds hang disconsolately from split, useless masts. Turnbuckles that secured many a deckload of lumber lie rusted on racks under the forecastle heads...Men of the sea, without derision, refer to this final resting place of forgotten ships as "Rotten Row" (McNairn and MacMullen 1945:121-122).

Shasta languished on "Rotten Row" until November of 1937 when she sank to her deck level, slightly heeling over to port. She was raised by her underwriters, who promptly sold her to new owners planning to take her out of Oakland Creek, though not for use as an operable, coast-wise vessel. Her purchasers, a newly formed whaling company, moored Shasta in Drakes Bay for use as a reduction works plant. Her engines may have been removed by this time; her boiler was retained, however, to operate the reduction machinery. A shed was built forward of the superstructure, and her high poop was cut down for whaling operations, which apparently did not last long. Leaking, she was run aground, probably in February of 1939, on the rocky shores of Drakes Bay adjacent to the Fish Docks, where she settled to deck level, never again to float (Plate 14). Portions of the vessel were probably scrapped, but a significant portion of her structure remains on the bottom with the boiler periodically exposed during low tides.

Marin County Coastal Trade Vessels

The rapid influx of a large population and the resultant growth of urbanization in San Francisco, a lack of local farms, factories, and ranches, and the isolated character of the region made the city almost entirely dependent upon seaborne goods - even for such staples as butter, flour, meat, vegetables and fruit. On December 12, 1850, for example, the brig Fawn, 20 days from Lahaina, Sandwich Islands, brought 123,560 pounds of sweet potatoes, 201 barrels of Irish potatoes, 15 barrels of onions, 20 hogs, 973 gallons of syrup, and 5 dozen fowl (Rasmussen 1966:80). Through most of the Gold Rush years (1848-1858) most staples and goods came from Europe, the eastern seaboard, South America, or the Sandwich Islands. As ranches and farms began to proliferate along the coast, however, coastal trade began to supplant farther ranging ships. By 1855, "the Pacific coast had joined the Eastern United States as the chief commercial partner of the city" (Lotchin 1974:47). By 1859, the majority of ships entering the Golden Gate were engaged in the coastal trade.

The dominant factor in the rise of the coastal trade had been the tremendous increase of farms and ranches. Many gold seekers, finding that instant fortune was an impossible dream, turned to California's richest resource--fertile

farmlands and millions of acres of prime grassland that was ideal for beef and dairy cattle ranching. By the mid to late 1850s, dozens of farms and ranches in the immediate vicinity of San Francisco were supplying the city's growing market. In particular, the large Mexican ranchos in the Point Reyes region as they were subdivided, sold and developed, became the major suppliers of butter, cheese, milk and produce to San Francisco. The proximity of the Point Reyes region to San Francisco gave it an edge over competing rural areas. The proximity was only by sea, because many miles of muddy roads, forests, hills, and streams separated Point Reyes from its urban marketplace. Initially, rather than develop roads, the ranchers of Point Reyes used the sea as their highway. Schooner landings were built in the protected waters of Drakes Estero. These small, shallow draft schooners (Plate 15) could load their goods there, cross the bar of the estero at Limantour Spit, and then sail along the 40 miles to the Golden Gate. The use of schooners persisted for many years, despite the fact that in 1874 the North Pacific Coast Railroad began shipping goods from Point Reyes to the southern Marin shore, and then by ferry into the city:

> ...many of the tenant ranchers preferred still to send their produce by schooner to the city. For one, the accessibility of the Drakes Bay landings to the ranches outweighed the long wagon ride to Point Reyes Station, over rough, often muddy roads. Besides, marine transportation probably was more economical at times because the schooners were owned jointly by Point Reyes ranchers and landowners (Toogood 1980, I:155).

In addition to the schooner landing in the estero, another was located inside Tomales Bay north of Inverness, still another landing for small lumber schooners that traded between San Francisco and Bolinas (usually carrying firewood) was located inside Bolinas Bay. The site of the latter is now a California Registered Historical Landmark (number 221).

The schooners were vital to the economy of the ranches. Not only did they ship the refined goods of the ranches to market, they also brought feed and grain from the city. The schooner called at the landings at Drakes Estero every Wednesday, "adjusting its arrival to the tide. It came back on Saturday if asked to" (Mason 1970:64-65).

The shallow inlet to the estero, the fierce Point Reyes winds that whipped across the bay, and the shifting sands made navigation of schooners a dangerous proposition. Small sailing schooners eventually gave way to gasoline-powered schooners that used sails when advantageous and ran their small Corliss engines to navigate the estero. The first gasoline schooner on the trade was <u>Nettie Lowe</u>, built, owned, and operated out of San Francisco. The ranchers were partners in this and many subsequent ships through the purchase of vessel shares.

Plate 15. The two-masted Pacific coastal schooner Maid of Orleans (built 1882) under sail in the Straits of Juan de Fuca, ca. 1900. Maid of Orleans was one of hundreds of two-masters that plied the waters of the Pacific coast, which included the two-masters Frances, Anne, Colonel Baker and Ida A., all wrecked in Drakes Bay. Photograph by Hiram Hudson Morrison, National Maritime Museum, San Francisco.

The rough conditions of the Point Reyes trade continued to wreck ships, even the gasoline schooners. Between 1871 and 1913 a total of four Point Reyes schooners were driven ashore in Drakes Bay to become total losses: Anne, Frances, Valentine Alviso, and Colonel Baker. At least five other schooners were grounded in Drakes Bay but later rescued (Plate 16).

Anne: Little is known of the schooner Anne (also known as "Annie"), the first Point Reyes schooner in the trade to be lost. She was apparently anchored in Drakes Bay in the company of another schooner, Frances, on February 20, 1871, either having discharged or loaded a cargo. A strong southwest gale blew up and drove both schooners ashore. The gale was unusually severe, damaging at least half a dozen other coastal schooners from Humboldt Bay south to San Francisco. Four schooners were reported with split main or jib sails, and two schooners reported that heavy seas had washed away part of their deck cargoes. The storm also caused considerable property damage in San Francisco, in one case knocking a fire wall over onto a two-story building on Montgomery street, killing four persons (San Francisco Daily Alta California, February 21, 1871).

On February 24, 1871, the San Francisco Daily Alta California simply reported that schooner Frances of Bolinas and the schooner Anne of Point Reyes were ashore, and that Anne was a total loss. Frances was refloated after the storm and continued to serve her owners for another eight years before being driven ashore in Drakes Bay again, then to become a total loss.

Frances: It is assumed that Frances, lost in 1879, was the same ship stranded along with Anne in 1871. On April 2, 1879, the San Francisco Daily Alta California reported that:

> The schooner "Frances", which runs to Point Reyes, got ashore last week near the Point, but got off, and, on attempting to come to sea again, went ashore the second time and now lies ashore, full of water, and with a couple of planks out of her bottom.

On the 12th, the Daily Alta added:

> The schooner "Frances" is a total wreck at Point Reyes. We have previously reported this vessel as ashore and badly damaged at that place, but the latest report is as above.

Valentine Alviso: Virtually nothing is known of the schooner Valentine Alviso. She was apparently named for Valentine Alviso, a prominent Californio of Alameda County who had been educated in Massachussetts, served as a county supervisor, a state assemblyman, and worked at the San Francisco branch of the United States Mint. The name may suggest that the schooner had originally operated on the

Plate 16. Schooner Ida A. grounded in Drakes Bay.

bay, calling at East Bay ports. She was apparently an old ship or very small, and perhaps both, since the San Francisco Examiner of September 10, 1883, noting her loss, stated that "the wrecked schooner Valentine Alviso was insured for $800, nearly her full value."

Little is known of the wrecking of Alviso. A very brief announcement of the loss of Valentine Alviso appeared in the September 8, 1883, edition of the San Francisco Chronicle. Listed under "Disasters" in the Marine Intelligence section, the announcement stated that the "schr. Valentine Alviso went ashore September 6, at 11 p.m. near Point Reyes, and will be a total loss." According to a manuscript chart of San Francisco Bay region shipwrecks compiled by United States Coast and Geodetic Survey head George Davidson (author of the most comprehensive Pacific Coast Pilot ever written, that of 1887), Alviso was driven ashore in Drakes Bay near Drakes Beach. Alviso was apparently lost in another winter gale. Within the section detailing the wreck of Alviso, the total loss of the British bark Windermere was noted two miles north of Fort Ross.

Colonel Baker: The last Marin County trade schooner to be lost was the 76-ton, two-masted scow schooner Colonel Baker. Baker, a veteran of the coast trade, was built in 1864. The ship was named for Colonel Edward Dickinson Baker, a prominent San Francisco politican and ally of Abraham Lincoln, who became an Oregon State Senator in 1860. In 1861, when serving as a colonel in the Union Army, he was killed while leading his regiment into combat at the battle of Ball's Bluff. Mourned as a martyr on the Pacific coast, Baker's name was chosen for a California vessel launched while the Civil War still raged.

Prior to her employment at Point Reyes, Colonel Baker had carried firewood from Bolinas to San Francisco. At the time of her loss, though, she was carrying $1,000 worth of hay bound for Point Reyes ranches. On November 6, 1913, while being towed across the bar into Drakes Estero by the gasoline boat Seven Bells, Colonel Baker went ashore when the tow rope parted approximately 1/2 mile east of the estero entrance. The seas drove the ship ashore before Captain Freethy and his single crew member could do anything.

As the ship pounded ashore, her deck load of hay was carried off, further lightening Baker and moving her higher up the beach, where her crew easily disembarked. Within a day, the old schooner began to leak and break up. The total loss of Colonel Baker was reported in the November 8, 1913, edition of the San Francisco Examiner. The value of the ship was placed at only $1,400.

General Coastal Trade 1848-1939

Annie E. Smale: General coastal trading vessels such as Annie E. Smale carried diverse cargoes along the Pacific coast, including lumber, and occasionally making passages to transpacific ports. Built in Marshfield, Oregon, in 1903, Smale was a four-masted, 809-ton schooner (Plate 17) owned by Swayne and Hoyt of

Plate 17. The four-masted schooner Annie E. Small, lost at Point Reyes on July 10, 1910. National Maritime Museum, San Francisco.

San Francisco (also the owners of the unlucky steam schooner _Pomo_). _Annie E. Smale_, despite her young age, was apparently not in good condition, perhaps due to a lack of maintenance. According to Fred Klebingat, who sailed in _Annie E. Smale to San Francisco in 1909,_

> The _Smale_ was very far gone and needed new spars and numerous repairs. Swayne and Hoyt, the managing owners, apparently did not have money to spare, so we put her on the mud at high tide on Mission Flat. She was there a few months and then they fixed her up for a trip to Australia. (Klebingat 1983:2).

Klebingat, reminiscing with members of the staff of National Maritime Museum, noted that the voyage he made in _Annie E. Smale_ almost ended as the ship leaked and was soon so full that she stood in danger of foundering. The steam pump worked but required the assistance of the hand pumps to clear the water from _Smale_'s hold. The pumps were broken, and the captain had the crew carve replacement parts from wood to repair the hand pumps and save the ship (Kortum 1983).

On July 10, 1910, while carrying 1,408 tons of coal consigned to the Canadian Bank of Commerce, _Annie E. Smale_, 99 days out from Newcastle, New South Wales, caught in a dense fog, drifted onto the rocks directly below the Point Reyes Lighthouse. The schooner had been slowly making her way through the fog all night. There was almost no wind, and the fog was so thick that Captain J. E. Anderson was unsure of his position until he heard the warning blast of the Point Reyes fog signal. He immediately ordered all sails set and every effort was made to wear her out to sea. Suddenly the ship ground to a halt. On running forward, he discovered that "the bowsprit had poked a hole in the cliff" (_Daily Morning Call_, July 10, 1910). Sounding, Anderson found that _Smale_'s bow was resting on a rock ledge with deep water aft of amidships. Fearful that the heavily laden vessel might slip back and slide off the ledge, or perhaps break in two, the captain gave the order to abandon ship.

Everyone except the second mate, who evidently agreed to stay on board, stepped into the lifeboat and pulled away. Included in the group were the captain's wife and nephew. At daybreak, the wreck was discovered by the lighthouse keeper, who sent a distress signal and alerted the Life-Saving Station's crew. A passing steamer, _M.F. Plant_, saw the distress signal and picked up the boatload of survivors, sending a boat to _Smale_ to take off the mate. When the Life-Saving Service crew arrived, they took Captain Anderson and two of his men back to the ship to remove some papers and personal belongings. Placing their possessions in a lifeboat still hanging from the davits, the three men tossed a line to the waiting surfboat, cut the tackles, and let the Life-Saving crew tow them clear of the ship. After hoisting the men and the boat aboard, _M. F. Plant_

returned the favor by towing the surfboat windward of Drakes Bay so that the crew could row with the wind to their backs.

Several attempts were made to pull Annie E. Smale off the rocks. On Sunday, July 10, the day of the wreck, the Pacific coast steam schooners Lagua, Acme, and Rainer took turns trying to pull the stranded schooner off the rocks. In every case the towlines parted. Finally, on Monday, July 11th, the ship broke in half, and the stern section slipped into deep water. By the 12th, one mast was reported standing, but the wreck was awash and fast going to pieces (Daily Morning Call, July 14, 1910).

Smale was valued at $40,000, the cargo at $60,000. Only gear insurance was carried. The loss of Smale was a hard blow to her owners and it was even harder for the captain. Anderson's share in the vessel represented years of savings and, since he and his wife had made their home in the ship, most of their personal belongings had been lost. Later, Anderson claimed that many of his personal effects might have been saved if the Life-Saving Station crew had lent a hand. At the official inquiry, Captain Anderson reported to Inspector of Boilers, Captain Bulger, and Inspector of Hulls, Captain Bolles, that the accident was due to the heavy fog and a strong inshore current which had carried the ship onto the rocks. The only lives lost, he noted, had been those of his canary and one pig.

Richfield: Oil was discovered and commercially developed in California as early as 1865. At first, the west coast oil fields were too limited to pose a threat to the eastern seaboards's petroleum industry, but ultimately they were responsible for "a revolutionary transformation of the economies of southern California and the coast" after a spectacular series of discoveries in new fields over the decade 1892-1901 (Pomeroy 1965:116). By 1901, Standard Oil of New Jersey had developed a large oil refinery on the shores of San Francisco Bay, bringing scores of new vessels carrying crude oil along the coast to San Francisco. By the 1920s, the trade had blossomed, giving a tremendous boost to the port of Los Angeles, which by dint of additional southern California oil discoveries had grown by 1923 to handle more tonnage than San Francisco (Pomeroy 1965:305). As early as 1919, Los Angeles County was producing approximately 10,000,000 barrels of oil; by 1920, production stood at 15,076,633 barrels, valued at $20,805,754 (Hamilton 1921:320). Thus by 1928, one local historian could proudly report that Los Angeles harbor:

> ...has eight giant loading stations to serve the hundreds of tank steamers which annually call. Last year (1927) 107,598,056 barrels of Southern California's oil went out past the breakwater light, bound for Pacific anAtlantic domestic ports and for the Orient, South America and Europe (Ludwig 1928:314).

Just as in the Pacific coast lumber trade, the oil carrying trade also required specialized ships. These were the bulk carriers, the "tankers," surpassing the carrying capacity of their antecedents, which only carried oil in steel barrels. Specific types of machinery, particularly pumps and heated tanks, were needed to carry certain cargoes, such as wax or crude oil, gasoline or fuel oil. Specialized tankers were developed, then, with specialized machinery to handle cargoes. There were also general carriers that could transport crude, gasoline, or fuel oil in separate tanks (Morrell 1931).

Increased opportunities in the California petroleum trade attracted established oil companies and sparked the organization of new firms, one of which was the Richfield Oil Company of Southern California. In 1925, the company purchased the tanker Brilliant for their expanding operation. Brilliant, built in Lorain, Ohio, in 1913, was a 3,240-ton steel bulk carrier, 250 feet long with a 43-foot beam and a 26-foot depth of hold (Plate 18). The ship's capacity was 23,500 barrels of oil or gasoline, and was fitted with two steam-powered pumps capable of discharging 1100 barrels per hour. Brilliant was a modern ship, built with longitudinal frames that prevented buckling in the plates and stiffened the vessel. Earlier tankers built without longitudinal framing had structurally failed. By 1931, longitudinal framing had proved so successful that it had "practically been adopted as the basis of Lloyd's new rules for scantlings of oil-carrying vessels..." (Morrell 1931:77).

After purchase from the east coast owners, Brilliant sailed through the Panama Canal to reach Los Angeles, where she was rechristened Richfield and became the flagship of the company's growing fleet. Inaugurating a regular oil and gasoline supply run between Los Angeles and San Francisco Bay for her new owners, the ship performed well despite a tragic accident in 1928. While being overhauled at the Union Iron Works yard in San Francisco, the ship was damaged when two of her tanks exploded, killing two men and injuring five others. After repairs, the ship was put back into service with a reputation for being a "jinxed" vessel.

The vessel was lost on May 8, 1930, while enroute to Portland, Oregon, with 25,000 barrels of high-grade gasoline. Sailing from San Francisco at 7:40 a.m. on May 8th on the last leg of a voyage from Long Beach to Portland, Richfield encountered heavy fog and a stiff northwest breeze that made headway difficult. To avoid the strong wind, Captain Lee of Richfield ordered a course laid close to shore. Around noon, the ship struck a submerged reef about 500 yards south by southeast from the tip of the Point Reyes peninsula near Chimney Rock. According to Captain Lee, the ship had been picked up by a "giant comber," carried inshore, and dropped on the reef. According to the San Francisco Examiner of May 9th, a hidden rock raked the side of Richfield, whirled her around such that another rock disabled her rudder, and the ship had then drifted helplessly until striking the reef (Plate 19). Upon striking, the ship immediately began to flood through several large holes torn in the hull

Plate 18. The petroleum bulk tanker, Richfield, ex-Brilliant. Atlantic Richfield Company, Los Angeles.

Plate 19. The wrecked Richfield off Chimney Rock, Point Reyes. Atlantic Richfield Company, Los Angeles, California.

Plate 20. View from the deck of the wrecked Richfield. Atlantic Richfield Company, Los Angeles.

(Plate 20). As the sea water poured into Richfield, her gasoline cargo began to leak into the surrounding ocean. Fearing an explosion, Captain Lee ordered his 30-man crew into the lifeboats to abandoned ship.

Meanwhile the grounding had been witnessed by a lookout at the nearby Life-Saving station, and a motor launch was on the way. Arriving at the wreck, the motor launch towed the three lifeboats from Richfield away from the gasoline-covered water to safety. Most of the crew were transferred to the Coast Guard cutter Smith and taken back to San Francisco, with Captain Lee and a hand-picked few remaining to help direct salvge efforts. The Coast Guard succeeded in attaching a 500-foot towing hawser to the stranded tanker. The Red Stack tug Sea Rover made several unsuccessful attempts to pull Richfield off the reef, but heavy seas battered the ship, shifting her some 300 yards from her initial position. At sundown the efforts to save Richfield were abandoned and the tug Sea Salvor was ordered to stand by the ship and await the morning, when salvage operations would again commence. On May 9th, Sea Salvor pumped out much of Richfield's 25,000 barrels of gasoline. Richfield's keel was broken, however, and efforts to refloat the ship were abandoned.

The ship remained on the reef until she was broken up. A mariner's warning was posted by the Coast Guard prohibiting open fires at sea while passing the wreck until the ship was torn apart by the surf and the remaining gasoline cargo dispersed. Local wreck divers have visited Richfield's shattered hull, which they describe as tons of broken, jagged metal wedged in the rocks of the reef.

Munleon: By the 1920s, steel-hulled ships had begun to replace the older wooden-hulled vessels that had plied Pacific coastal waters prior to the Gold Rush. While many wooden vessels continued in the coastal trade, most major shipping companies were turning their attention to the larger, stronger, and in most cases, faster steel freighters. An early firm to switch from wooden hulls to steel was the Charles R. McCormick Steamship Company. McCormick, a successful lumber magnate, had entered the shipping business in 1904, primarily to bring his own lumber to market. Later, the steamships under the McCormick flag carried passengers and general cargo in addition to lumber. One of the vessels used by McCormick was the Frederickstad class freighter Lake Fabyan (Plate 18). The ship was renamed Munleon after purchase from the U.S. shipping board. The vessel was lost under the McCormick flag at Point Reyes on November 7, 1931. Munleon was one of the hundreds of standard design steel vessels built during and immediately after World War I to offset the tremendous shipping losses inflicted by German U-boats. Like the "Liberty" and "Victory" ships of World War II, these vessels were rapidly built to one general plan with little variation. Known as "Frederickstad" class vessels, the design had been

developed in Norway, provided for a three-island riveted-steel general cargo vessel with one deck and two

masts. It would be powered by a triple-expansion steam engine of from 1,250 to 1,550 horsepower (Wilterding 1981:1).

The contracts to build the Frederickstad ships were issued to shipyards on the Great Lakes. It was at Wyandotte in the yard of the Detroit Shipbuilding Company that hull number 264, _Lake Fabyan_, was launched in 1919. _Lake Fabyan_, like all Great Lakes ships, was of a slightly modified design to fit the canals connecting the lakes with the sea. Most of these hulls were built with a beam of 43 feet 6 inches or less. These ships were popularly called "Lakers" because of the Great Lakes variation of the Frederickstad design. _Lake Fabyan_ was owned by the United States Shipping Board, who evidently sold the finished vessel to the McCormick Steamship Company of California after her launching, inasmuch as the war had ended and there was no further use of the ship. Many "Lakers" completed after the end of the war were sold in a like manner.

Sailing for McCormick, _Munleon_, ex-_Lake Fabyan_, typically carried manufactured goods to the Pacific Northwest via Portland and Seattle. On her return passages to San Francisco she generally carried lumber (Plate 21). With her massive triple-expansion steam engine and large holds, _Munleon_ represented the last seaborne phase of the lumber trade, which had grown from a fleet of small, easily maneuvered sailing schooners calling at narrow "dog-hole" ports into a major operation with large steel freighters calling at principal lumber ports, such as Portland, Seattle, and Vancouver. Eventually the freighters were replaced by rail and truck transportation of lumber.

Munleon's last voyage began inauspiciously on November 7, 1931, when she loaded 800 tons of general cargo, principally sugar, radio sets and cigarettes, at the Oakland Pier. Clearing for Portland at 7 p.m. with a crew of 28, _Munleon_ left the harbor and headed north. Near Duxbury Reef, some 10 miles north of the Golden Gate, _Munleon_ entered a fog bank. Shortly thereafter the steel freighter crashed head-on into the rocks of the Point Reyes Headlands at full speed (Plate 22). Running at approximately 11 knots, _Munleon_ struck with such force that the third mate, in charge on the bridge, was injured when he was hurled into the bulkhead. Sleeping crew members in the forecastle below were tossed from their bunks. An SOS signal for immediate assistance was flashed where it was intercepted by the San Francisco _Examiner_'s radio station at 10:15 p.m. The last distress call at 10:29 p.m., also intercepted by the _Examiner_ station, reported _Munleon_'s "holds were filling rapidly and that he (the radio operator) was shutting down" (San Francisco _Examiner_, November 9, 1931).

The distress signals were also picked up by the United States Coast Guard. At 10:30 p.m. a Coast Guard rescue boat from the Point Reyes Life-Saving Station was dispatched.

The Coast Guard launch arrived at the wreck scene at 11:00 p.m., and stood by as a lifeboat when an eight-man crew was lowered from the stricken ship. Three

Plate 21. The steel freighter Munleon, ex-Lake Fabyan, moored off the 16th Street dock, San Francisco, having just discharged her cargo of lumber. Note sign on dock for Richfield Oil Company; Richfield, flagship tanker of the Richfield Oil Company, had been lost the year before, 1930, at Drakes Bay. Munleon would also be lost in the same general vicinity, just eight months after this picture was taken in March 1931. Photograph by John W. Proctor, National Maritime Museum, San Francisco.

Plate 22. <u>Munleon</u> aground and a total loss at Point Reyes, November 8, 1931. Photograph by John W. Proctor, National Maritime Museum, San Francisco.

separate trips of the lifeboat were made between the sinking Munleon and the launch until 25 of the 28-man crew had been taken off. Meanwhile, the safety valves had been opened in the engine room, averting a possible boiler explosion. No one was badly hurt and the evacuation proceeded so smoothly that seaman Emil Holstrom, who had evidently been shipwrecked before, was recorded as stating that Munleon's loss was "the nicest little shipwreck I was ever in.... Nobody got his feet wet and only two men were scratched up" (Evans 1977:165). After depositing the 25 rescued crew members on shore at the Life-Saving Station, the Coast Guard launch returned to Munleon to take off Captain Otto Hengst and the two remaining crewmen, the first officer and a winchman. The three men elected to stay on board, Captain Hengst was unwilling to surrender his ship to the salvors. Finally, about 5:30 a.m. on the 8th, just 10 hours after the ship struck, Munleon sank an additional 16 feet. Captain Hengst sent up flares indicating that he was at last ready to abandon ship.

Later that day, two representatives of the Board of Marine Underwriters arriving on the Red Stack tug Sea King visited the wreck. All that day and the next few days heavy seas pounded Munleon, ripping off her forward bottom plates and steadily breaking her apart. Within a few days the McCormick Steamship Company declared Munleon and her cargo total losses and abandoned the ship to the mercy of the rocks and waves. After an investigation, the licenses of Captain Hengst and Third Mate Chris Nielsen were suspended for two and three months, respectively. As reported in the San Francisco Chronicle of November 18, 1931, the Captain was disciplined for "inattention to duty." This was because Hengst had allowed Nielsen to alter the ship's course off Point Reyes without being on the bridge himself;

> Captain Hengst had made out the usual night orders directing the officer in watch to change the course when Point Reyes Light was abeam, but left the bridge to go to his room before the point was reached. As this is one of the most dangerous course changes on the coast, it is customary for the master of a ship to attend to it himself.

Nielsen was reprimanded and disciplined for "unskillfulness in mistaking Drakes Bay flashing buoy light for the Point Reyes light and changing the vessel's course too soon." According to the Chronicle:

> The inquiry brought out the fact that Nielsen mistook the Drakes Bay light, which is 12 feet above the water and flashes every 15 seconds, for the Point Reyes light, which is 294 feet high and flashes every 5 seconds.

A similiar mistake had sent the lumber schooner Hartwood to her grave just a few hundred yards away in 1929. Nielsen's defense, which claimed that the fog had

reduced visibility almost to zero and made navigation nearly impossible, was rejected.

Munleon was launched too late to participate in the war for which she had been designed and built. She had a rather uneventful career which involved only one other marine casualty. The vessel broke a propeller in 1931 and had to be towed into San Francisco.

After the wreck the ship remained fast on the rocks, protruding above the water until December 27, 1931, when a savage winter storm broke her apart (San Francisco Chronicle, December 28, 1931). Her shattered remains have periodically been visited by sport divers. The remains of Munleon were located and partially mapped in October 1982 during the submerged cultural resource survey.

Fishing

Lizzie Derby: Beginning in 1787, whalers began to harvest the Pacific Ocean's cetacean population. By the 1830s, dozens of whaling ships were plying the coast, using San Francisco Bay as a provisioning and rest stop. Following the Gold Rush, San Francisco became an active home port for whalers as the Atlantic whaling grounds became depleted and hundreds of ships made their way to the Pacific. The Pacific whale industry soon began to diminish because of financial panics; the fledgling but considerable competition of synthetic replacements for whale oil and the American Civil War had all but ruined the industry by the late 1860s. In the 1870s, the discovery and active harvesting of the Arctic whaling grounds, the decline of New Bedford as a whaling port, and a rise in prices revived San Francisco's dwindling whaling trade. By the 1870s, steam whalers operating out of San Francisco commenced a new era in American whaling. By 1883, San Francisco was a major whaling center. There was a whale oil refinery in town, a large new whaling concern, the Pacific Steam Whaling Company, "a growing local fleet of modern steam whalers, and virtual control of the Pacific fleet, San Francisco...could rightly claim to be the world's principal whaling center" (Crawford 1981:74).

The exploitation of the Arctic and North Sea whaling grounds also gave rise to another maritime industry: sealing. During the Spanish and Mexican eras of California history, sea otters had been harvested along the shore, the most notable operation being that of the Russian American Company at Fort Ross on the Mendocino coast. The sea otter population declined just prior to the Gold Rush (Ogden 1941). By the 1870s, with San Francisco whalers opening the Arctic and reaffirming stories of large rookeries of seals, dozens of sealing schooners began to make their way north. By the 1870s harvesting the seal was a lucrative business; in addition to the valuable fur coats of the animals,"...the layer of fat adhering to it yields the oil of commerce, and supplies light and heat to the natives..." (Scammon 1874:14). The usual practice of sealing called for

herding the seals and dispatching them with clubs. At other times seals were taken by boat in the open sea. A typical San Francisco sealing schooner of the early 20th century was described by author and mariner Jack London in his novel The Sea Wolf:

> The men were all on deck and busy preparing their various boats for the season's hunting. There are seven boats aboard, the Captain's dinghy and the six which the hunters will use. Three, a hunter, a boat puller, and a boat steerer, compose a boat's crew. On board the schooner the boat pullers and steerers are the crew. The hunters too are supposed to be in command of the watches, subject always to the orders of Wolf Larsen.... The Ghost is considered the fastest schooner in both the San Francisco and Victoria fleets. In fact, she was once a private yacht, and was built for speed...the Ghost is an eighty-ton schooner of a remarkably fine model. Her beam, or width, is twenty-three feet and her length a little over ninety feet (London 1964:47-48).

Traditionally, the sealing schooners were small, fast craft, usually adapted from an earlier use. One such vessel was the schooner Lizzie Derby. Built and launched on San Francisco Bay by the California City shipyards of Marin County in 1869, Derby was 80' 5" long with a 25' 7" beam and a 7-foot depth of hold. She was registered at 93.02 tons, and was probably two-masted. Little is known of her early career. It is probable that she was engaged in the coastal trade, for the San Francisco Daily Alta California of February 24, 1871, noted that Derby had collided with the schooner Fanny A. Hyde off Stewarts Point, Mendocino County.

> The schooner Fanny A. Hyde...during a southeast gale, was run into by the schooner Lizzie Derby, carrying away fore rigging, foresail, and everything attached, breaking rail and staving bulwarks. The damage to the Derby was not ascertained, but she left her figurehead on the deck of the Hyde.

Ironically, this brief glimpse of Derby's career was found in the same column that reported the loss of the coastal schooner Anne at Drakes Bay, where Derby would eventually be lost. If the above incident is at all indicative of Lizzie Derby's career, one wonders how she ever managed to survive another 20 years before being cast ashore at Drakes Bay.

Derby was enroute to the sealing grounds when she was finally lost, having sailed from San Francisco on February 12, 1891, for the Bering Sea. She carried 21 crew members and six boats. After battling a southwest gale for two days,

Captain Scott at the urging of his crew ran Derby into Drakes Bay for shelter on February 14th. Both anchors were set, but the gale soon increased to such force the schooner began to drag. The sea was too rough to permit the crew to escape in the small boats as Derby neared the shore. All that could be done was to hang on and keep at hand something for a life-preserver should Derby go to pieces in the breakers. Incoming rollers carried away or smashed all the lifeboats. The schooner held together, and at 10 p.m. Lizzie Derby thumped ashore. Although the giant breakers battered the old schooner throughout the night, she continued to hold together as she was forced higher up the beach. Finally, by morning she was high enough that the crew, one by one, were able to leap over the side of the ship and run for safety between the rollers.

At low tide the crew were able to return to Lizzie Derby, which was "lying on her side pretty well caved in" to gather their belongings. Captain Scott was able to save his charts and instruments.

The absence of good roads and the difficulty of travel by land between the wreck site and San Francisco is illustrated by the crew's two-day ordeal to reach the city. After a long walk to Bolinas, they negotiated a wagon ride over the mountains to San Rafael. Walking from San Rafael to Sausalito, they finally caught the "noonboat" to San Francisco, arriving on February 16th. The wreck of Lizzie Derby was reported in the San Francisco Examiner of February 17 under the heading "Another Sealing Wreck." As the first two paragraphs of the article pointed out, Derby was not the only sealing vessel to be lost that season:

> If the sealing season continues as disastrous as it has opened there will be no need for revenue cutters in the Bering Sea, or further hair-splitting between the diplomats.
>
> Two of the English pirates have met with disaster on the north coast, and the schooner Lizzie Derby of this port made a trio by going ashore at Drakes Bay Saturday night. There was no loss of life, but the Derby will not decrease the fur seal to any extent this season.

According to the San Francisco Chronicle of the same date, which also noted the loss of the ship, Derby was one of 54 sealing schooners that had already or were about to sail in February for the Bering Sea Sealing Grounds. Thirty-seven British sealers, 16 Americans, and one German sealer were named. No further mention of Lizzie Derby was made. She apparently was not salvaged and eventually broke up completely.

NAME	DATES	TYPE	CONSTRUC-TION	LENGTH	BREADTH	DEPTH OF HOLD	TONNAGE	CARGO	VICINITY OF LOSS	COMMENTS
San Agustin	? -1595	Manila Galleon	Wood	80'	22-23'	13-14'	200	Merchandise	Drakes Bay	
Ayacucho	? -1841	Brig	Wood					Silks, Brandy, Merchandise	Drakes Bay	Anchor may still be with hull remains
Nahumkeag	1846-1867	3-Masted Bark	Wood	1,110'	24'6"	11'2"	$290^{80}/95$	Lumber	Drakes Bay	Square stem, single deck, 11' hold depth.
William Ackmann	1881-1883	Steam Schooner 1 Deck, 2 Masts	Wood	104'	$29^{3}/10'$	7'	$144^{00}/100$	Posts and Bark	West end, Point Reyes Beach	Lost 1/2 mile from Point Reyes, auxilliary steam.
Pomo	1903-1913	Steam Schooner 1 Deck, 2 Masts	Wood	130.5'	32.6'	10.7'	368 gross	Blue-Butt Redwood	Drakes Bay	Single ender, round stern.
Hartwood	1916-1929	Steam Schooner	Wood	$199^{3}/10'$	42'	$14^{1}/10'$	946 gross	Mixed: Wire cable, pipe, sugar	Point Reyes headlands	Double ender, machinery amidships.
Shasta	1908-1939	Steam Schooner	Wood	192.3'	41'		878 gross	None	Drakes Bay	Converted to whaler, double ender, Scotch boiler visible.
Anne	? -1871	Schooner	Wood						Drakes Bay	
Frances	? -1879	Schooner	Wood	$41^{5}/10'$	17'	$3^{45}/100'$	$16^{20}/100$		Near the point of Point Reyes	
Valentine Alviso	1866-1883	1 Deck, 2 Masts Schooner	Wood	43'	19'	$4^{8}/10'$	$26^{86}/100$		Near Point Reyes	Elliptic stern.
Colonal Baker	1864-1913	Scow Steamer	Wood	75'	25'6"	5'9"	$82^{63}/95$	Hay	$^{1}/2$ mile east of estero	Square stern tuck. Was high on beach when broken up, south spit Drakes Bay.
Annie E. Smale	1903-1910	4-Masted Schooner	Wood	200'	40.6'	16.4'	809	Coal, 1408 tons	Directly below Point Reyes Lighthouse	On rock ledge with deep water aft of amidships.
Richfield	1913-1930	Bulk Oil Carrier 2 Decks	Steel	250'	43'	26'	2,486 gross	Gasoline	Off Point Reyes headlands	Longitudinal framing.
Munleon	1919-1931	Freighter	Steel	251'	43.6'	26.1'	2,606 gross	General cargo	Point Reyes headlands	Riveted, one deck.
Lizzie Derby	1869-1891	Sealing Schooner Single Deck	Wood	$80^{5}/10'$	$25^{7}/10'$	$7^{2}/10'$	$98^{10}/100$	Outward bound for sealing	Drakes Bay	Forced aground by breakers.

Figure 6. Compilation of Known Vessel Losses in the Survey Areas of
Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary
(Dimensions are from enrollment documents or coasting trade license - ed.)

Figure 6. Compilation of Known Vessel Losses in the 1982 Survey Areas

VII. PHASE I REMOTE SENSING SURVEY

Introduction

A survey for historical shipwrecks, that is conducted from a research perspective within a managerial framework, is fundamentally different from a search for individual shipwrecks for commercial exploitation or for satisfying the esoteric interests of individual archeologists. Proper management of any area is based on a comprehensive knowledge of that particular area, including the locations of fragile cultural resources that must be monitored and protected, as well as a knowledge of where these resources are not located, so that protection efforts will be directed to where they are needed. Survey and testing methodologies must be minimally destructive, reflecting the overall research objectives of conservation and interpretation, not exploitation.

Consequently, survey methodology must be effective but controlled and rigorous, with minimal impact on the resources during all phases. The primary tools utilized in this survey were remote sensing instruments, which are inherently non-destructive. This constitutes a Phase I survey that is performed to answer the question: Is there historical material present in this area? Occasionally, this information is all that is needed to resolve a managerial problem, such as whether cultural resources are going to be impacted by a construction project or other activities. Generally, the cultural resource survey of an area involves a second or Phase II program of intra-site magnetometer delineation and "ground truthing," employing a site-sampling strategy in order to evaluate site areas. During sampling operations, there is tight control over the amount of bottom disturbance so that the impact to the site is reduced. The principal reason for emphasizing minimal disturbance to a site during the Phase II survey is that most shipwrecks appear to reach a comparatively stable state of preservation within their environment at some point after initial deposition. Test excavations and other disturbances invariably upset the equilibrium of a site in direct proportion to the amount of area that is disturbed.

A critical element in conducting remote sensing surveys and site evaluations useful for managerial purposes is accurate positioning. Thorough planning and precise positioning of the survey transects are important to ensure that all target shipwreck remains within the survey area will be located and properly evaluated. This approach is often initially more expensive and somewhat slower than random searches of high probability areas. It is, however, more cost-effective and efficient in the long run. A primary advantage is that an accurately positioned survey produces a great deal of useful data, which are cumulative. Even if only negative evidence is obtained, it is useful. An accurately delineated survey area in which no cultural resources are found may confidently be identified as an area of low sensitivity, or "cleared," in the archeological sense. An accurate Phase I survey normally needs to be conducted

only once, however, additional high-resolution magnetometer coverage of anomaly clusters is useful in most cases to delineate cultural areas and to determine the precise location of test excavation points.

The Drakes Bay survey was a Phase I survey relying on electronically positioned remote sensing. The primary remote sensing tool was the magnetometer, and secondary instruments were the side scan sonar and sub-bottom profiler. This survey, like most surveys, was limited by temporal and fiscal constraints. In order to obtain the best results, those that can be used by resource managers as well as by archeologists and historians, a detailed survey design was developed and is presented below as part of this report.

Survey Strategy

The survey of Drakes Bay was designed to accomplish three tasks: to detect the ferrous components of wrecked vessels within a delineated zone of high probability; to detect extant cultural remains present above the sea floor within the bay and in close proximity to the headlands and Pacific coast area; and to determine the nature of the bedrock strata and depth of the overburden that would have to be removed during test excavations. Information was obtained by using remote sensing data generated by the magnetometer, side scan sonar and sub-bottom profiler. Electronic positioning for the survey and optical repositioning for testing were chosen to give the highest data return possible within the allotted amount of time for the survey and ensuing test and evaluation phases. Ideally, electronic positioning would be used for all phases.

Historical background research was done prior to and after completion of the field work (Chapter IV). Prior archeological work in the area was also reviewed (Chapter III). The background research provided information concerning potential targets that was needed for the design of the survey.

The survey was to focus solely on the location of remote sensing targets that represent historical materials. Although there may be a potential for submerged terrestrial prehistoric sites, it was not considered in this survey design. The sampling parameters were specifically directed toward the location of historic shipwrecks.

The common assumption is that shipwreck locations are the result of chance. Although shipwrecks are often found in locations that the people on board were actively trying to avoid, the existence of the Point Reyes shipwrecks is a direct result of patterned human behavior, they are not chance depositions that occurred in a cultural vacuum. The composition of the vessels, their contents, and their locations were all affected by and reflect the economic and historical development of the northern California region. These vessels are potentially important repositories for data about the historical and cultural development of

this region; thus the investigators working on this project have approached the survey from a regional perspective. The realization of the research potential of the Drakes Bay shipwreck population lies within the regional context. Consequently, the vessels are not viewed as discrete units but rather as interrelated cultural carriers with regional ties.

Because the project was a survey and not a search for a specific vessel, the remote sensing profile was designed accordingly. Had the survey focused on a search for one particular vessel, a different remote sensing profile might have been needed. Instead, the survey was structured so that the largest possible area could be surveyed, and so that there would be a high probability that all significant historical remains would be detected.

Shipwrecked Vessel Types

The earliest documented loss is the Spanish Manila galleon San Agustin. The vessel was lost while conducting explorations of Drakes Bay and Estero on a return trip from the Philippines in late November, 1595. She was apparently anchored offshore, to the west of the mouth of the estero, when a heavy wind from the south wrecked her (Aker 1965:35-49). The vessel was a total loss, and little or no salvage was conducted by the crew. After 1595 there are no reported wrecks until the brig Ayacucho was lost on Limantour Spit in November, 1841. Captain Limantour evidently mistook Drakes Bay for San Francisco Bay and provided the name for the spit that claimed his ship (Evans 1969:23).

There are at least 72 recorded marine disasters that occurred between 1840 and 1940, leaving more than 30 shipwrecks in the area of Drakes Bay, off Point Reyes, and along the Pacific coast of Point Reyes Beach (Evans 1969:113,117). These marine disasters do not include local boats, fishing vessels or prehistoric craft. Vessel loss resulted primarily from navigational errors that were made while passing Point Reyes or from pilot errors that were made when coastal schooners in the bay were trying to negotiate the estero opening.

The size and nature of wrecked vessels must be considered during survey design. A responsible shipwreck survey is designed so that all potential sites within a designated range can be detected. It is important to determine beforehand what the range of detectable vessel types is to be, as opposed to the entire range of vessel types likely to be present within the survey area. The smaller vessels likely to be present within this survey area range from the 200-ton San Agustin and the smaller 84-ton schooner Rachel (1895) to the 72-ton American schooner Colonel Baker that was lost in 1913. The larger vessels range from 300-ton steam schooners (e.g., Pomo, 368 tons, lost 1913), and clippers and barks (e.g., Haddingtonshire, 1,119 tons, 1885), to metal-hulled vessels of 2,000 tons (e.g., Richfield, 2,366 tons, 1930 and Francis Coppee, 2,289 tons, 1903). Unrecorded vessels may include other early exploratory vessels as well as ships, boats and fishing vessels. The types of vessels likely to be found appeared to be divided

into two general classes. The smaller and older vessels were navigating or at anchor within the bay and the larger vessels seemed to cluster on the Point and Point Reyes Beach areas. On this basis, three general zones were identified: the bay margin, the bay proper and the coastal margin of the Point and Point Reyes Beach (Figure 7). In order to maximize the potential for locating shipwrecks, different remote sensing instruments would be used for each zone. The magnetometer would be the principal survey instrument in the area of zone 1, and the side scan sonar would be utilized to maximum efficiency in zones 2 and 3. A discussion of the survey design for each zone follows.

Survey Zones

Zone 1 is the primary target area for locating the oldest and smallest of the vessels that are historically documented in the area. Maritime activity in this area generally focused on Drakes Estero. San Agustin was reportedly lost while exploring the estero. Schooners involved in the coastal trades traveled in and out of the mouth. Vessels were also wrecked at the mouth of the estero because those on board believed they were entering San Francisco Bay. This is the area in which there is the greatest possibility of locating unrecorded smaller local craft that were wrecked. The increased siltation of the estero through time may have contributed to the loss of the later vessels of the schooner trade.

Zone 1 is the coastal margin of Drakes Bay from 1/2 mile offshore to the beach, centered on Limantour Spit. This area would be subject to the most intensive survey effort using a magnetometer, positioning the survey vessel electronically and in a high-resolution mode.

Zone 2 is the area within Drakes Bay above the 38th parallel. This zone would receive saturation coverage by electronically positioned side scan sonar. A number of positioned sub-bottom profiler runs would also be carried out to determine the nature of the geological substrata. The side scan sonar survey would be directed at locating vessel structures that extend above the sea floor.

Because the bay is protected from the prevailing offshore breakers, it could be used by large numbers of sport divers. Sport-diving explorations of the bay would normally be limited to features above the sea floor, since excavation is prohibited and such obvious violations are normally easy to monitor. The results of the side scan survey should include the location of cultural material accessible to divers and would enable park management to monitor those locations.

Zone 3 encompasses the narrow coastal shelf along the Point Reyes headlands and Point Reyes Beach. It is the location of the majority of the more modern wrecks which are historically documented. The rocks provide a foundation for a rich diversity of marine fauna and flora and as a result this area receives heavy visitation when weather conditions permit. Zone 3 is the third priority, and is

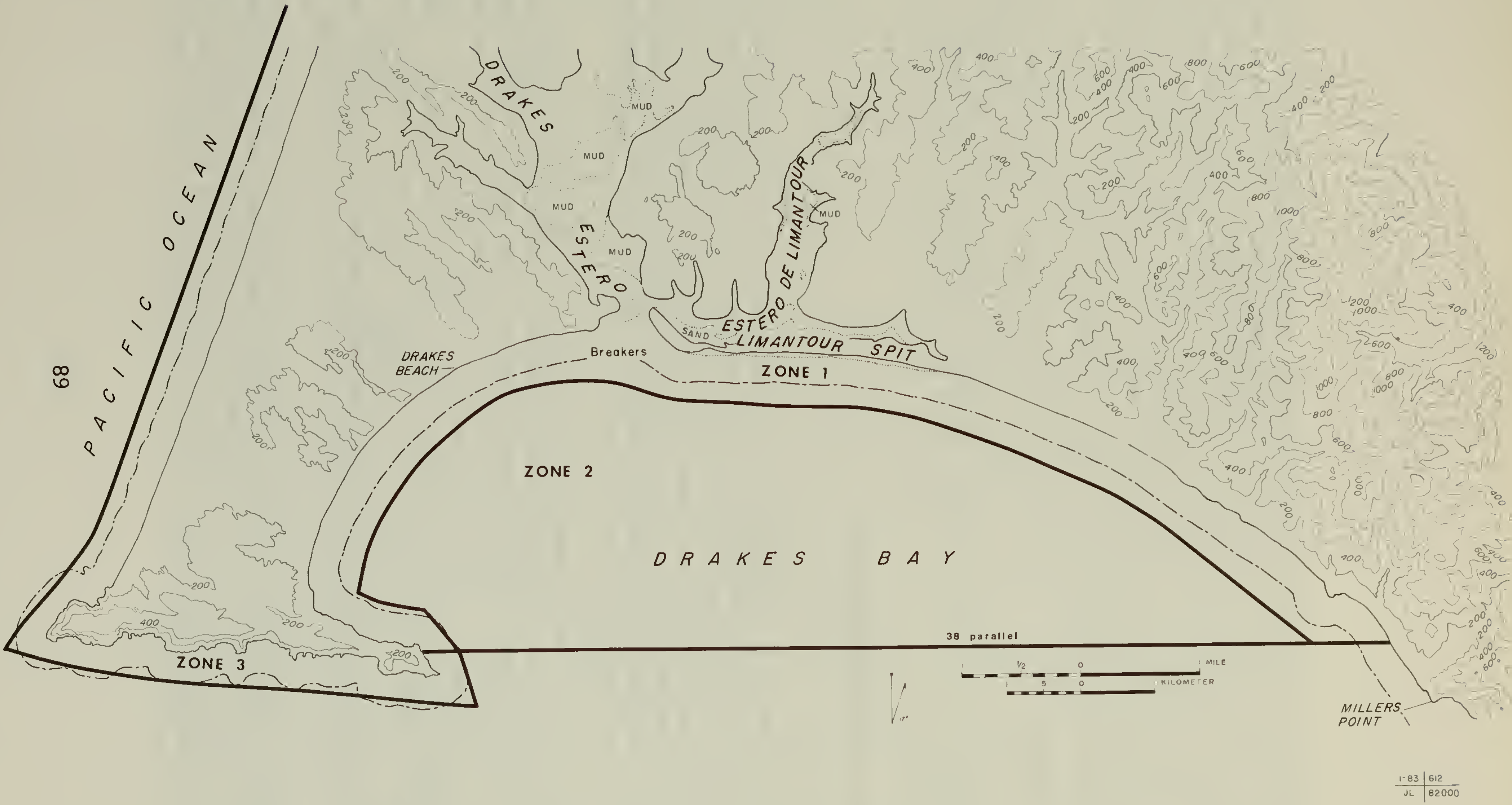


Figure 7. Survey Zones, Drakes Bay Shipwreck Survey 1982

targeted for a semi-controlled side scan sonar survey, but it would also be the area in which most of the project diving takes place, since the expected side scan sonar contacts would be ground-truthed. The zone 3 work was designed to locate any vessel hulls that may lie within the park boundaries off the Point. The park boundary corresponds roughly to the 60-foot contour that leads west along the southern edge of the Point past Chimney Rock. The shelving on the Point Reyes Beach is the steepest part of all the survey areas and the survey transects were planned close enough to the cliff face to give the resolution necessary to identify cultural remains among the rocks.

The survey along the Pacific coast (Point Reyes Beach) was the most difficult part of the project because it had to be carried out during satisfactory tide and weather conditions, when the Pacific breakers were low enough to allow a safe survey pass to be run and to produce an acceptably quiet record. The lane was run at the contour depth of 30 to 50 feet, with the concentration on the shoreward scan.

Survey Methodology Rationale

Magnetometer

Data produced by the magnetometer can only be assessed after they are reduced to a usable format. During the survey, anomalies can be observed as they occur, and a buoy can be thrown to mark them for immediate examination by divers. This technique has often been used successfully for locating wrecks during a shipwreck search. This is not sufficient, however, when it is necessary to know the position and relationships of many different anomalies in order to obtain an accurate assessment of a survey area for managerial purposes.

Phase I magnetic reconnaissance survey data are usually displayed using symbols that indicate the intensity and, sometimes, duration of a magnetic anomaly in the location of occurrence on a scale map of the survey area. The symbols depict graphically the distribution and relative size of ferrous materials in the surveyed area. Simple anomalies and cluster areas can be examined and prioritized for in-water evaluation. The evaluation is normally referred to as Phase II. Ideally, a Phase II program should include a magnetic survey of target areas on very close lane spacing, on the order of 10-15 meters, to delineate the anomalous area and produce magnetic contours of the area useful for pinpointing the precise location of the ferrous mass creating the anomaly.

Contouring is recognized as the most efficient and useful means of reducing and displaying magnetic data, and has become the most common method of presentation (Breiner 1973; Arnold 1975; Murphy and Saltus 1981). The contour map is similar to a topographic map and is constructed of lines drawn to represent equal magnetic intensities, much like the contours of a topographic map that represent equal height.

Certain ferrous masses (e.g., those of a shipwreck) are often said to have a recognizable signature. Signatures can refer to the specific trace of the recording pens on the chart paper as the survey vessel passes the area affected by the ferrous mass of the target, or it can refer to distribution or clusters of anomalies or to the pattern of contours mapped after the data are collected. The magnetic contours of a sailing vessel would have a typical magnetic signature that contains a central area of magnetic distortion, which is characterized by a number of internal and localized anomalies and which is surrounded by smaller magnetic disturbances (Arnold and Weddle 1978:198). The intense, localized anomalies most often reflect the positions of the ship's guns, anchors, concentrations of fittings (in early ships) or perhaps deck machinery and rigging (in later period sailing vessels).

However, even a typical signature configuration of anomaly clusters or contours cannot be used as conclusive evidence of a wreck. It could also indicate a concentration of more modern cultural materials that are unrelated to a shipwreck, but that produce a similar signature. In all cases, diver investigation is necessary for "ground truthing," to determine the source of the magnetic anomaly. The contours are most useful in prioritizing anomalies for investigation, and in positioning the test excavation (Murphy and Saltus 1981). When a magnetic anomaly is recorded, it simply means there is ferrous cultural material of unknown origin and signficance in a specific location. Once a shipwreck is located, a high resolution intra-site survey can be very useful for delineating the extent of the scatter and the size of the site. Complete excavation of a 1554 Spanish Plate Fleet vessel revealed that fewer than 10 of the more than 1,500 individual artifacts were located outside the 5 gamma contour line around the site (Arnold and Weddle 1978:198). It should be pointed out that more than 85% of the artifacts recovered were permanently fixed in conglomerates of 100 to 1,000 kg, which probably formed within the 10 to 20 years following the wreck (Clausen and Arnold 1976:166). This may not be the case for vessels in different environments and consequently, smaller artifacts may be scattered beyond the area of magnetic anomaly contours. Shipwreck sites may be more widely scattered than the wrecks of this example.

The vessels most difficult to find within Zone 1 of the survey are San Agustin and schooners of less than 100 tons. These vessels would be the smallest targets, therefore the most difficult to locate during the intensive magnetometer survey. The survey design would have to be structured so that anomalies attributable to ferrous components of these vessels would have a very high probability of detection. Ferrous components would be ships' guns, anchors and fittings, in the case of San Agustin; and anchors, fittings, winches and other machinery, in the case of the later wooden-hulled schooners. If the magnetometer survey is designed around these smaller vessels, then the chances of not detecting any other vessels in the area would be quite small. Non-ferrous vessels such as Indian canoes, ship's launches, and small local vessels would probably not be detected.

There are few physical details of San Agustin to be gleaned from known historical documents (Aker 1965:69-71 provides the synopsis from which this discussion was taken). The vessel was probably not over 200 tons (an estimate which may be light considering the amount of cargo), it carried 130 tons of cargo, and embarked with about 90 persons, including passengers, soldiers, and crew. Aker projects a vessel length of about 80 feet, a beam of 22 to 23 feet, with a draft of about 13 to 14 feet. It was mentioned that San Agustin carried a deckload of chests and other cargo, some of which were lost during an August hurricane while outbound from Mexico. Regarding the ship's armament, Aker states that it is not mentioned in any of the literature he reviewed, but it would likely be restricted to a few light pieces carried on the upper deck to leave the "tween decks" unencumbered by artillery.

A brief examination of documents about and the material record from other 16th-century vessels will give some insight into the kinds of large ferrous artifacts that may have been on San Agustin.

Schurz (1939:13) notes that usually the only soldiers aboard vessels of this period were the prescribed number of gunners. Soldiers present aboard San Agustin indicate probable presence of ship's guns. In the early years of the Manila trade, arming usually meant issuing small arms to those on board. However, the capture of Santa Ana on the lower California Coast by Cavendish in 1587, and the threat posed by Drake's operations in the Pacific apparently caused the Spanish to arm their vessels with larger guns. The report of Governor Vera to King Phillip II in 1588 stated "the ships are well supplied with artillery, all the passengers have arquebuses, swords and bucklers; the seamen carry at least a sword, and each ship is armed with pikes, partisans, large stores of powder and munitions, bombs and grenades" (in Schurz 1939:213). This is still no guarantee that the galleons were well armed. Even if they were, goods often choked the upper deck so that it was impossible to operate the guns (Schurz 1939:213; Peterson 1975:62; Haring 1918:209, 216-217), and sometimes they were even dismantled and stored in the hold above the ballast, as observed on the 1715 Spanish Plate Fleet wrecks in Florida.

The most complete and professionally reported excavation of 16th-century vessels in the New World was done by Texas Antiquities Commission archeologist J. Barto Arnold, III (Arnold and Weddle 1978). Three ships of the 1554 Spanish fleet were engaged in the Spain-Indies trade, and were wrecked off Padre Island while sailing from Vera Cruz to Havana on their way back to Spain. Two of the three vessels were excavated - San Esteban (41KN10) by Texas archeologists, and Espiritu Santo (41WY3) by commercial treasure hunters. Reconstruction of a keel section (Doran and Doran 1978:381) gave an estimated tonnage of 286 tons for San Esteban. The main body of each site was estimated to be about 30x50 meters (Arnold and Weddle 1978:188), and the magnetic deflections covered some 80,000 square meters.

Santa Maria de Yciar, another vessel of the 1554 fleet, was a 200-ton vessel (p. 29, 81), and, according to the ship's register, would carry 10 pieces of large artillery and 22 versos. The verso was a light piece of wrought iron that operated as a breech-loading swivel gun. Excavation of the San Esteban site produced three ship's guns of the bombard type. Bombards are built-up, wrought-iron hooped-barrel, breech-loading guns. One was stored in the ballast and two were probably in use. Two of these guns had remnants of their wood stocks and fiber lashings. Five versos and three bombards were recovered from Espiritu Santo. These bombards weighed about 100 kg (220 lbs) with separate breech blocks weighing up to 140 kg (300 lbs). The versos weighed from 41kg (90 lbs) to 104 kg (228 lbs) (Olds 1976:75-84).

It is quite possible that San Agustin carried similar types of armament. Other types of iron guns used throughout the 17th century (Hogg 1970:83-84) that may have been on the vessels are the falconet (a wrought iron gun weighing 500 lbs) and the falcon (800 lbs). The Royal Ordinances of February 13, 1552, made it mandatory for ships of between 170 and 220 tons that were involved in the West Indies trade (Spain to America) to carry 1 Falconet (of brass), 8 Lombards ("lombards" and "bombards" are often used interchangeably), and 18 versos (Haring 1918:274). These ordinances may have had little bearing on the vessels engaged in trade with Manila, but they do indicate the way in which vessels of a similar class were armed.

The late 16th-century Spanish merchant vessel (sunk ca. 1596) that was discovered in Bermuda and is referred to as the "Tucker-Canton Treasure Ship" was carrying both heavy and light weapons (Peterson 1972a:90). The weapons were versos and cast-iron falcons (Peterson 1975:274), although one iron gun that came from the wreck is labeled a falconet (p:276). Another wreck that was found in Bermuda and is known as the "Highborn Cay Wreck" (ca. 1560-1580) produced 11 swivel guns (versos) (Peterson 1972b:256) and two bombards. The vessel's size was estimated at 200 tons, and 65 tons of ballast were located (Peterson 1972a:87). The bombards were thought to be bow chasers. An illustration of one in the same reference (p. 88) shows that it looks very similar to the bombards on the 1554 vessels. Three anchors were found with this wreck, two were deployed, and one was on the ballast pile (Peterson 1974:232).

Anchors are the other class of large ferrous object that may be found on the wreck site of San Agustin. Although anchors have been located on other 16th-century shipwreck sites, only the anchors from the 1554 wrecks have been described and documented. The vessel Santa Maria de Yciar had four anchors aboard (Arnold and Weddle 1978:24). The site of San Esteban (41KN10) produced seven anchors ranging in weight from 104 kg (232 lbs) to 428 kg (950 lbs); four of the seven anchors weighed over 230kg (500 lbs) each (Arnold and Weddle 1978:Appendix J/Table 51). Five of the anchors, three of which were broken, were apparently stored with the ballast (Arnold and Weddle 1978:224). Peterson

(1974:234-236) also discusses 16th-century anchors found near Bermuda, although no weights or dimensions are given.

The anchors from the 1554 fleet are probably not as heavy as those that were carried on San Agustin, even though the vessels were similar in size. During the late 16th century, ground tackle was developed, cables were lengthened, and the weight of anchors increased (Waters 1958:8). Although San Agustin was lost while at anchor, there were probably other anchors aboard that were not deployed.

Although some of the contents of San Esteban were salvaged by the Spanish, it still contained about 12,000 kg of metal and other artifacts (Arnold and Weddle 1978:195). This could be considered a minimum amount for San Agustin, since no salvage has been documented.

For purposes of the Drakes Bay survey design, the ferrous target mass was considered to be 454 kg (1,000 lbs). Closely spaced magnetic survey lanes over the San Esteban site prior to excavation (sensor to target distance of 6.5m) produced a 30-gamma deflection from a single 345-kg component. Several ferrous components (two bombards and two forged-iron breech blocks) weighing 590 kg produced a broad anomaly of only 15 gammas. This phenomenon is a result of magnetic cancellation that can be produced when several normally dipolar magnetic objects are situated in such a way that the magnetic field is smaller than it would be for a single object of similar mass. The highest deflection from the wreck of San Esteban was 125 gammas, which was created by out-of-service armament and anchors. Deflections of 10 to 15 gammas were created by iron fasteners and concentrations of rigging. The 125-gamma reading would be in the range of 3 gammas at 22.5 meters sensor-to-target distance (produced by a 45-meter survey lane spacing) and would probably be indistinguishable from background noise (Clausen and Arnold 1976:167).

Extensive magnetometer survey and evaluation of the 1554 wreck led the Texas archeologists to the prediction that colonial period shipwrecks could be detected using 45-meter-wide lane spacing. This was later verified during the test excavations of various anomalies (Arnold 1977:27). A distance of 50 meters had been recommended previously as the maximum lane spacing with the sensor not more than 6 meters off the bottom (Clausen and Arnold 1976:168). This would mean that under ideal conditions (calm weather and a straight vessel track) a magnetic target would be no farther than 25 meters (82 feet) from the sensor head (considering some overburden and requisite geometry for a sensor depth of 6 meters above the bottom). At this distance, a 909kg (one-ton) ferrous mass would give an estimated reading of about 4 to 5 gammas (interpolated from Breiner 1973:43). (Interpolation may vary by a factor of 2 to 5 depending on specific conditions.) Using the 50-meter lane spacing, the 454kg (1,000-lb) Drakes Bay survey target mass would produce a reading about half that size, possibly making it indistinguishable from background noise.

Therefore, 30-meter lane spacing was chosen for the Point Reyes magnetometer survey. At this distance, the 454kg target mass would produce an estimated minimum 10-gamma anomaly at the farthest distance from the sensor within the zone 1 survey area. This lane spacing was successfully used during a recent National Park Service search for a legally contested shipwreck in Biscayne National Monument (Murphy 1980). Using 30-meter transects for the Point Reyes magnetometer survey provided a cost-effective and efficient survey coverage, with a high probability of detecting the full range of potential shipwrecks in zone 1.

Side Scan Sonar

Ideally, side scan sonar is run concurrently during a magnetometer survey. The console can be set on one of the lower slant scale ranges to produce a high resolution saturation coverage. However, side scan was not available for the zone 1 magnetic survey. Side scan survey of this area was included in the zone 2 survey completed during the second survey session.

The purpose of surveying zones 2 and 3 was to locate large cultural remains above the sea floor within the bay. Knowing these locations will enable park personnel to monitor sport-diving activity, which is often focused on visible wreck remains. Small objects were not of primary concern. It was necessary to space the side scan survey lanes, so that the large area of Drakes Bay could be covered efficiently, with sufficient resolution to identify targets of interest for managerial concerns.

Extensive surveys done for the offshore oil industry provided the basis for side scan sonar lane specifications. Industrial concerns are locating lost equipment, wellheads, vessels, and any obstacles that may interfere with drilling operations. It has been determined that a 600-meter (1/3 mile) side scan path at a tow speed of 6 knots is sufficient for a 100 percent detection probability of large targets (intact ships, planes, etc.). Smaller targets require a narrower path to ensure detection (Kozak 1980:2). In order to locate smaller targets within the bay (such as small vessels, broken vessel components, and fishing vessels), a lane spacing of 300 meters was adopted to minimize the possibility of missing cultural material in the zone 2 survey area. This transect spacing would allow twice the resolution as a result of halving the slant range from recommended spacing. Lanes in the zone 3 area along the south face of Point Reyes would be reduced still further to maintain the resolution necessary to differentiate cultural targets from the offshore rocks.

Sub-Bottom Profiler

The sub-bottom profiler survey took place entirely within Drakes Bay. The purpose of the sub-bottom profiler survey was not to locate cultural targets,

but to gather geological information. Geological data are important to the survey for two reasons: sub-bottom information is needed in order to plan test excavations in magnetic target areas, and an understanding of the dynamics of the bay is needed to reconstruct the geomorphological history of the area. Accurate planning for test excavations must be based on a knowledge of the depths of overburden that may be encountered.

Geomorphological information is important for an understanding of the changes within the bay since initial European contact during the late 16th century. A review of the brief historical descriptions indicates that the sediment depth may be increasing, and that the most prominent depositional feature, Limantour Spit, is an active area where the estero opening shifts periodically east and west. A knowledge of the geomorphological changes will make it possible to determine some of the natural impacts to cultural material, such as predicting burial or exposure of materials in certain areas and probable dispersal patterns of a wreck site. Knowing how specific features have changed will also allow a more accurate estimation of site locations discussed in historical documents and keyed to these features.

Natural impacts to shipwreck sites are presently little understood, and they have not received much attention during site excavations. An understanding of both cultural and natural site formations is necessary before the two can be separated for analytical purposes. The complex issue of natural impacts to shipwrecks has been raised by some researchers (Dumas 1962, 1966; Clausen and Arnold 1976; Murphy and Saltus 1981), but the only systematic discussion to date has been the work of Muckelroy (1977, 1978:160-65), who classified 20 wrecks in British waters by isolating the environmental attributes that were relevant to the state of preservation of each wreck. The importance of this research is that we can ultimately predict which shipwrecks within the National Park Service jurisdiction can best answer specific anthropological or historical questions. If an understanding of the natural forces and their impact to wreck sites could be developed for Park Service regions, it could be used as a powerful managerial and research tool. Destructive natural impacts to important wreck sites could be mitigated on a justifiable priority basis. Researchers would know which questions and hypotheses could best be answered by a specific wreck in a particular environment. If Park Service managers could make these determinations, they could make better use of the data base comprised of the protected wrecks of the National Park Service. These data would make it unnecessary to disturb a concentrated, well-preserved site that is located in a low-impact zone, if the same type of information could be as readily obtained from the investigation of less well-preserved sites that are located in more destructive environments.

Data from the population of shipwrecks within the varied environments of Point Reyes National Seashore may contribute much to the understanding of how shipwrecked vessels are preserved and how they are affected by natural impacts.

The sub-bottom profiler survey was carried out as an effort to formulate a data base that will be used as the testing of the wrecks in the bay progresses. The results of the sub-bottom survey can be used as comparative data for monitoring environmental changes within the bay, such as any changes that may have been made by the recent devastating winter storms of 1983 (see Appendix II). The sub-bottom transects were designed to produce a reasonable cross-section of the bay bottom. The near-shore track off Limantour Spit was run through an area of heavy anomaly concentration as determined by the earlier magnetometer survey.

The overall rationale for the survey methodology that was designed and used in Drakes Bay was to obtain as much information as possible that would be useful to managers as well as to researchers. The emphasis was on cost-effective utilization of equipment and personnel to generate a reproducible body of data. The ultimate test of the rationale is the quality of the data base that is generated and its applicability to other areas within the National Park Service jurisdiction.

Survey Instrumentation

Magnetometer

The magnetometer used for this survey was manufactured by EG&G Geometrics of Sunnyvale, California. The instrument is a recording proton precession magnetometer, model number G-866. The instrument is supplied with user selected components for terrestrial and marine applications. The marine sensor with stabilizer fins and drogue chute was utilized in this survey. The length of the sensor cable is 200 feet.

This instrument is powered by two 12-volt batteries in series and is controlled by using pressure-sensitive switches on the console face. Contained within the console is a dual-range analog recorder/printer. There is also a digital display and an internal clock.

A distinct advantage of this instrument is that the sample rate can be varied for specific applications. The rate can be varied from .5 to 999 seconds as desired. At a sample rate of 1 second, a .5-gamma sensitivity is maintained. Scale factors for the dual range printer can be chosen from the available options of 10/100, 20/200, 50/500 or 100/1,000 gammas. This is particularly useful when high resolution is needed for colonial-period shipwreck detection. Most magnetometer results trace only in the 100/1,000 range. Most of the Drakes Bay survey was conducted in the 20/200 range. In areas of high magnetic activity, a shift to 50/500 was usually adequate for minimizing scale changes. The recorder, which is actually an electronic printer, has the option of tracing the scale over the full width of the chart paper, or it will use half of the chart for a printed digital anomaly intensity readout. In the latter option,

the time of reading and the value of the reading in gammas is digitally printed on the dual-trace analog printout.

This was found to be a reliable instrument that contains special features for archeological survey that other kinds of magnetometers do not have. The one limitation of the 866 was that it produces data for computer interface in a serial BCD format (RS232C), and most current positioning systems require a parallel format. This can be overcome by constructing a circuit to produce the required output. Unfortunately, it was not currently offered by the manufacturer as an option.

Side Scan Sonar

The side scan sonar used during the survey was manufactured by Klein Associates, Inc. The specific instrument was the basic system, model 520, which consists of a 100 KHz tow fish (sensor head) and a two-channel recorder.

The tow fish has a horizontal beam angle of 1°. The vertical beam is 40°, tilted 10° below horizontal.

The printer has dual channels that print the port and starboard returns simultaneously. Each channel is printed on an 8-inch portion of the 19 1/4-inch-wide electrosensitive paper. The available range scales are 25, 37.5, 50, 75, 100, 150, 200, 300, 400 and 600 meters. Slant range lines, which are useful for determining contact distance from vessel track, are normally printed at 15-meter intervals from the centerline track, but can be adjusted from 2 to 25 meters. The printer has an automátic 2-minute mark and a manual event mark, each of which prints a straight line across the full width of the paper. An option not used during this survey, but which has application to other surveys, is a magnetic tape recorder for recording the sonographic data. The magnetic tape can be viewed on a video monitor to allow detailed analysis and could be subjected to edge enhancement or false color analysis useful for pinpointing cultural material.

The side scan sonar was leased from CCM Leasing of Escondido, California, and operated by Lance Fitzgerald and Carl Moller.

Sub-Bottom Profiler

The sub-bottom profiler used in the survey is known as a Uniboom, Model 230. The instrument array consists of a seismic energy source, electromechanical transducer, hydrophones and recorder. The transducer (Unit Pulse "Boomer") was mounted on a small catamaran raft that was towed abeam of the survey vessel. The acoustic impulse is generated by a high-power, short-duration pulse that is discharged from the seismic energy source into a coil, which generates a magnetic field that explosively repels a metal plate. The motion of the plate

which creates the acoustic pulse is transferred to the water through a rubber diaphragm just below the surface of the water. The energy source was a 220-volt AC generator. The returning echos of the pulses are received by a hydrophone streamer towed behind the pulse source. The resolution of the instrument approaches 6 inches. The frequency spectrum is 1 to 10 KHz. The depth of penetration depends upon the type of bottom sediment.

The use of the sub-bottom profiler was provided by the U.S. Geological Survey, Office of Marine Geology, Menlo Park. The field engineer operating the instrument was Dave Hogg of the U.S. Geological Survey.

Survey Methodology

Magnetometer Survey

The survey area was stratified into three different sampling zones. Zones 1 and 2 required precise positioning by the survey vessel during the course of the remote sensing with magnetometer and side scan sonar. Accurate survey positioning is a basic requirement for the production of reproducible and cumulative data. Because the project could not be completed during the 1983 field season, all anomalies produced by the survey instruments must have accurate positions to allow relocation in future field investigation phases.

Electronic positioning of the survey vessel is necessary. The principal advantages of electronic systems over the various optical techniques are: the ability to immediately view the results of the survey transect coverages; rapid individual position fixes (normally once per second); high accuracy (on the order of 1 to 2 meters); operation is not limited to periods of good visibility (a necessary consideration for the often fogbound survey area); and the storage of data magnetically which allows relatively rapid reduction by computer.

Electronic positioning is normally done from at least two land-based stations that transmit high-frequency radio waves in the microwave band (Plate 23). The wave patterns over the survey area form a lattice, which instrumentation on board the survey vessel uses to produce range/range distances by measuring elapsed time of signal travel from the shore-based stations to the vessel. A computer then converts the electronic trilateration into X-Y geographic grid coordinates. This information is updated every second and stored. An X-Y plotter is interfaced to give a real time position of the vessel on a scale chart of the survey area. The X-Y plotter is preplotted with the desired transects drawn over the survey area. Any divergence of the vessel from the preplotted transect lane can be immediately observed and corrected while the survey is taking place.

Accurate, reproducible electronic positioning begins with accurate locations of the shore based micro-wave stations. A visit was made to Drakes Bay by

Plate 23. Motorola Mini Ranger III reference station in position at Drakes Bay.

Submerged Cultural Resources Unit personnel prior to the proposed survey and positions were selected for horizontal control points for placement of the shore microwave stations. Eight general positions were selected to provide convenient locations for the shore stations (Figure 8). They were selected so that combinations of localities would allow complete coverage of Drakes Bay with close to ideal geometry. A second criterion for control point selection was to create a convenient network for optical repositioning of target sites at a later time when electronic positioning equipment might not be available. These shore stations would also serve as points from which surveillance of the bay could take place.

Eight control points have been accurately surveyed and tied to the Universal Transverse Mercator grid system as well as the California State Grid System (Appendix 1). Positions one and six are U.S.G.S. monuments. Positions three, four and five were located by a commercial land surveyor under contract to Point Reyes National Seashore. Positions two, seven and eight were surveyed using a Motorola Mini Ranger Satellite Positioning System (Plate 24). Mr. Bill Ewin operated the equipment which was provided by Motorola, Inc. The satellite positioning system is left in place on the chosen point and in 24 hours the computer is capable of generating a geographic position fix to the accuracy of +/- 10 cm. This is a highly efficient instrument which negates the necessity of bringing in established horizontal control to remote areas.

Zone 1, the area of high intensity magnetometer survey was subdivided into five survey areas (Figure 9). The coverage of these five areas is Figure 10. The areas were chosen to provide complete coverage in discrete units. Each area was completely surveyed before another was begun. In the case of inclement weather or equipment failure, this procedure would produce coverage that could be easily delineated and added to in future surveys. The magnetometer survey of zone 1 took place during the first field session in September (Plate 25).

The survey blocks were designed so that relatively long, straight transects could be followed. This format is normally the most efficient for preplotting and the most easily followed by the vessel pilot.

Field operation consisted of delineating a survey block. A preplotting program was executed and the transects were drawn to scale the length of the block (parallel to the coastline) and 30 meters apart. During the actual survey, the X-Y plotter drew a continuous line of the vessel track (Plate 26). Anomalies were marked on the plotter by hand for use during the survey. The geographic grid coordinates, time, lane number, and magnetic intensity were simultaneously recorded and stored on magnetic tapes. Buoys were thrown during the survey on areas of large magnetic anomalies or on clusters of anomalies as revealed by the hand-plotted positions on the plotter. This procedure allowed concurrent dive operations to check the area (Plate 27).

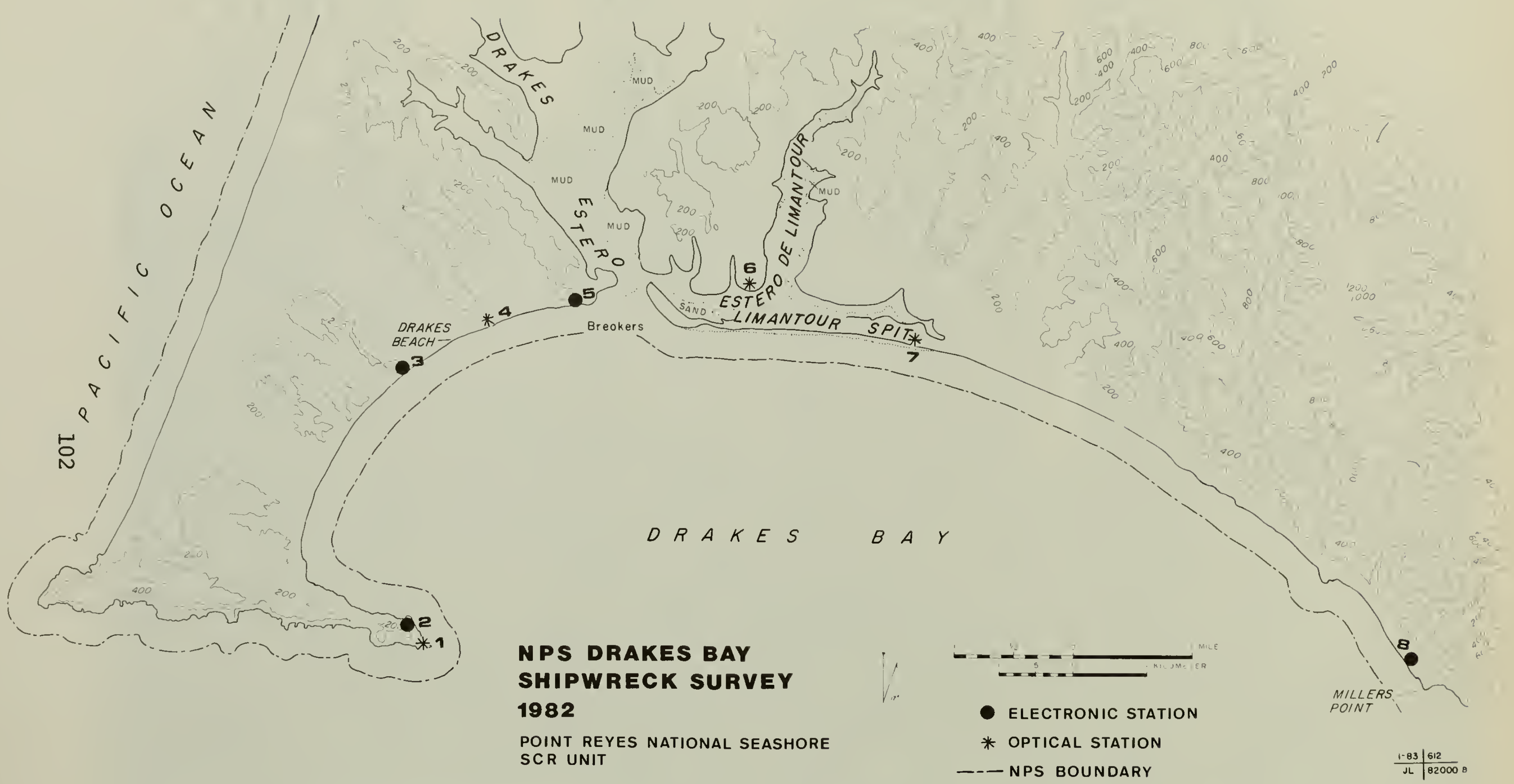


Figure 8. Horizontal Control Points Established or Used During 1982 Survey

Plate 24. Motorola Mini Ranger satellite positioning system on site at Drakes Bay. This instrument was used to generate coordinates for key reference station locations for the electronic positioning system. Photo courtesy Bill Ewin, Motorola, Inc.

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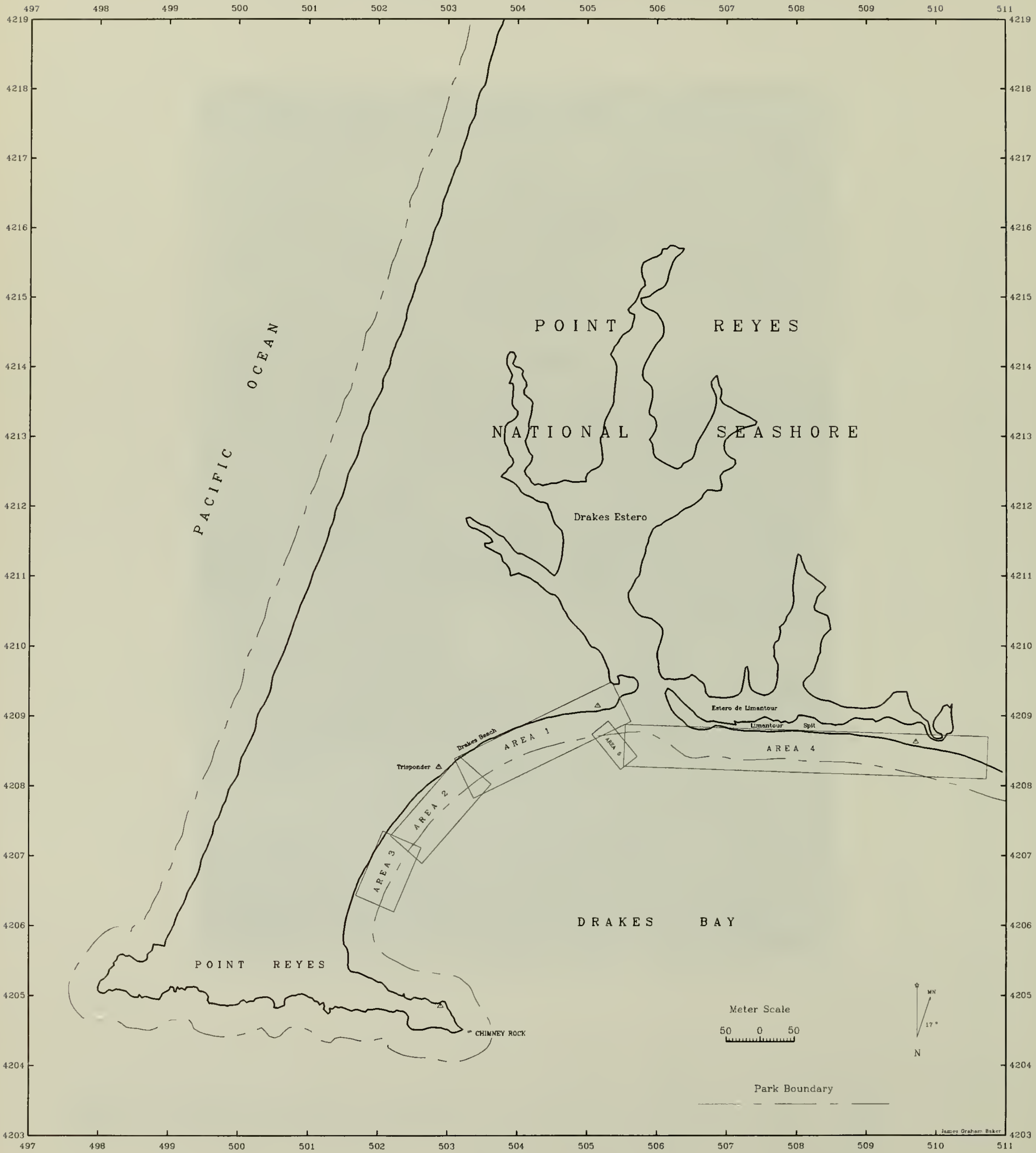


Figure 9. Study Areas of 1982 Shipwreck Survey. Survey blocks were established for magnetometer survey during the first field session.

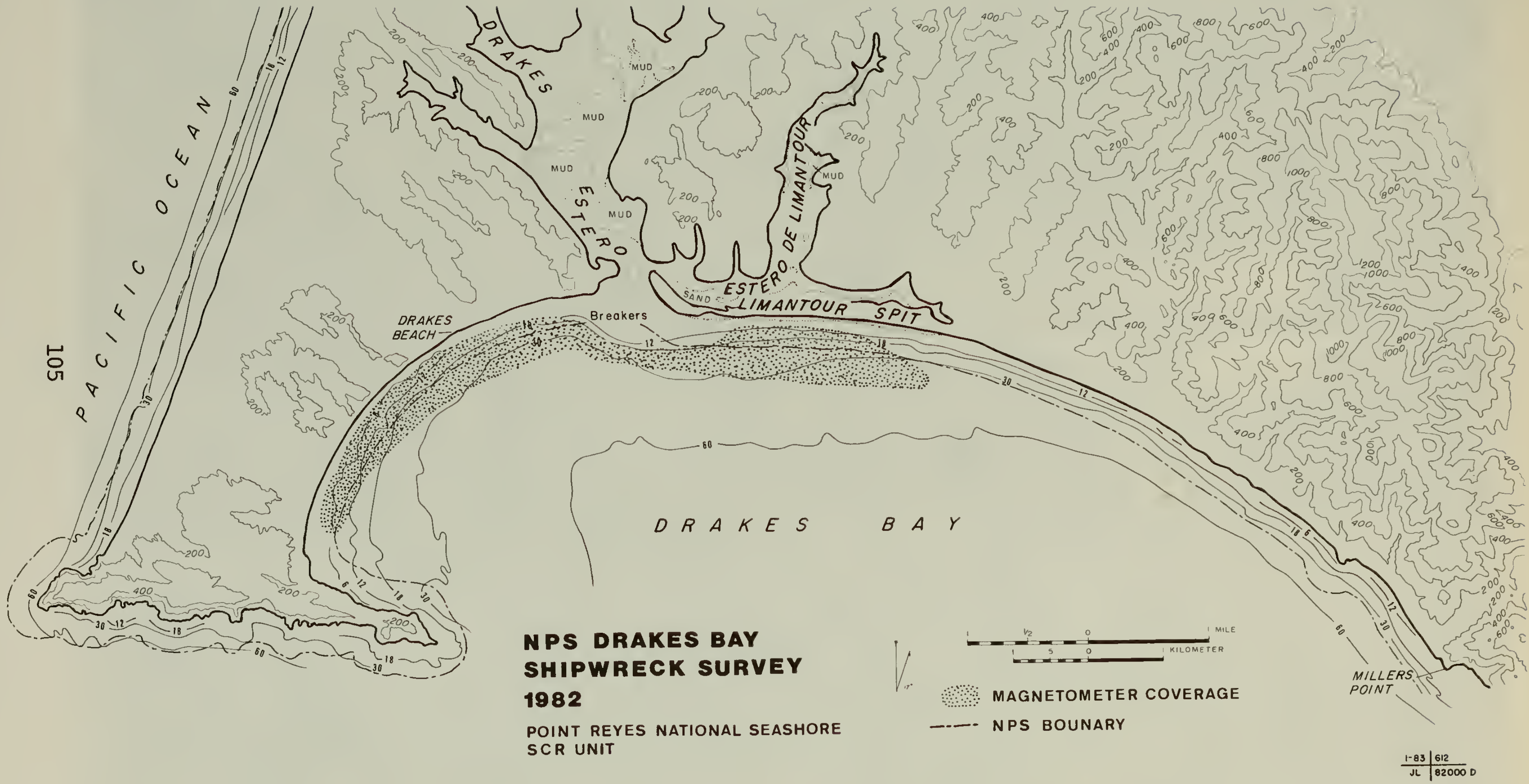


Figure 10. Magnetometer Coverage Completed During 1982 Survey

Plate 25. U.S. Coast Guard vessel (33 footer) used as the survey vessel during the first field session in 1982.

Plate 26. Magnetometer and positioning instruments during the first field session.

Plate 27. Point Reyes National Seashore and Submerged Cultural Resources Unit dive team during first field session.

Dive operations were carried out to determine two things: If there was visible material in the area, and if there was ferrous material detectable with a hand-held metal detector. In comparison to the magnetometer the metal detector has a limited range of ferrous detection. If a positive response was obtained from the metal detector, then it could probably be reached with the limited excavation equipment available. Controlled metal detector searches were carried out and few positive responses were obtained, which indicates fairly deep overburden in most areas.

Magnetic and positioning data were reduced at the Texas A&M computer center. Computer maps of the area were generated. The maps show the anomally intensity and location to scale. A list of magnetic anomalies, locations and intensity were produced. [Note: these data, which indicate specific site locations, are documents available only to park management].

Magnetic Data Reduction

The data were organized and reviewed, and the following information was obtained: for broad anomalies, a number of gamma values (anomaly intensities) and positions were recorded; for spikes, often only one position and a single gamma value was recorded. Throughout all lanes, the background noise was as high as 3 to 4 gammas. Some subjective judgement went into the selection and separation of anomalies from background noise. Anomalies with a value between +4 gammas and -4 gammas were particularly difficult to discern, and should be regarded as tentative.

The above process yielded a list of 684 anomalous readings. Still, the positions on this list were the positions of the vessel at the moment of sensing the anomaly, not the actual position of the anomaly--to obtain anomaly positions required further data processing.

All anomalous readings were input onto disk storage of the Amdahl computer and rechecked against the original list. A Statistical Analysis System (SAS) program was written to process the data to give the anomaly positions. Each area required two to four versions of the basic program. In area 3, for example, lanes were run in both a NNE and SSW direction; offsets (the distance the sensor was towed behind the boat) were at 22.5 meters and 30 meters at different times, depending on water depth. This meant four program versions had to be run to correct the coordinates for Area 3. Data for each different version had to be kept separate until all corrections were made. Only after completion could the data be combined into areas and the accurate anomaly position produced.

The coordinates of the corners of each survey area also had to be derived. The program used to adjust for the sensor offset was modified to compute the actual UTM coordinates of the corners for each survey area. A "known point" was

established for each survey area. Each "known point" was obtained when using the Del Norte microwave positioning system, and a buoy was deployed at the desired spot. The vessel was then brought alongside the buoy, and the line from the buoy to its anchor tightened. At that time a reading was taken on the Del Norte to give the X and Y UTM coordinates. This "known point" then became the reference point for the area, being used to initialize the plotting system at the start of each day (This procedure was not necessary with the Motorola Mini Ranger which was used during the second field session, during the side scan and sub-bottom survey).

Using the coordinates obtained from the "known point," it was possible to determine the corners of each area from angles and distances that could be taken from the plotter maps. The areas used for computer-generated mapping were the same dimensions as the preplotted areas from the plotter (except for Area 4 which was shortened to 5200 meters). Lanes 1 through 6 of Area 4 were deleted because they were too far inshore. Lanes 21 through 26 were added in the field to the original preplot of Area 4 to compensate for the deletion of lanes 1 through 6.

Area 5 was derived to encompass a series of lanes run to ensure fuller coverage of the mouth of the estero. The lanes from this area were run while the plotter system was initialized for survey in Area 4. For that reason, Area 5 is plotted on the same chart as Area 4. Once the data processing had produced final positions for the anomalies and survey areas, it was then possible to begin the production of maps.

A Versatec 8236 electrostatic plotter plotted all black-and-white maps. A Houston Instrument CPS-15 Drum Plotter drew the color map. All plots were created using FORTRAN subroutines from the NCAR package (as it was modified by Thomas Reid for use at Texas A&M University). Smaller 8 1/2 x 11-inch versions were plotted on a Xerox 9700 laser printer.

To provide a geographic data base, a USGS quad map was digitized with a Numonics digitizer, to reduce the shoreline and the Park boundary to a series of coordinates. These coordinates were later connected with a line fit to a cubic spline which reproduced a good facsimile of the georgraphic features. Onto this base were added titles, legends, features, and the survey areas, line weights, and the symbols for magnetic anomaly intensity designations. Coordinates can be passed to the plotter in any one of a number of superimposed, aligned coordinate systems including the UTM, Digitizer, and Versatec. The result of this process was the 1:24,000 scale map of Drakes Bay with the survey areas shown and labelled.

Next, the maximum and minimum extents of the different areas were determined and maps were dimensioned to be slightly larger than the maximum size of the areas; each area (except area 5 which was included on the Area 4 map) was enlarged and

plotted as a separate 1:2000 scale map. To do this the points at which the shoreline and beach enter and leave the 1:2000 scale maps had to be extrapolated from the digitized data. The dimensions of each map had to be carefully determined and those parameters passed to the plotter in versions of the basic plotting program.

The anomalies were categorized into five different ranges of gamma values:

1. Anomalies with a value from +4 to -4 gammas. (These were often difficult to distinguish from the background noise, making this a somewhat questionable category);
2. Anomalies with values from 5 to 9, or -5 to -9;
3. Anomalies with values from 10 to 14, or -10 to -14;
4. Anomalies with values from 15 to 19, or -15 to -19;
5. Those equal to, greater than, + or - 20 gammas.

Each anomaly was plotted using symbols that were positioned so they would be centered at the X-Y coordinates of the anomaly. This maps appears below in Figure 13.

Side Scan Sonar

The side scan sonar survey was carried out during the second session of field work. A Mini Ranger III Positioning System was provided by Motorola, Inc. to the project (Plate 28). It was operated by members of Submerged Cultural Resources Unit. CCM leasing provided an operator for the side scan sonar they leased to the Service.

Three-hundred-meter transects were preplotted through Drakes Bay. Side scan slant ranges were sufficient to give complete coverage. The runs were plotted east and west. Twelve runs were completed within the bay. Side scan runs were also done in Zone 3 along the south face of Point Reyes Headlands and along Point Reyes Beach (Figure 11). This area was outside the area of effective coverage by the positioning system. Survey lanes were maintained by the use of radar for distancing off the shore, and optical positions were taken with compass and sextant on known features of the coast.

Sub-Bottom Profiler Survey

The sub bottom profiler survey of Drakes Bay was a cooperative effort between the United States Geological Survey, Office of Marine Geology, the National Oceanic and Atmospheric Administration and the National Park Service.

This aspect of the survey took place during October 13 and 14 and consisted of four survey tracks: Runs 14 through 17 (Figures 12 and 14). Side scan sonar and magnetometer were operational concurrently on October 13 for run 14; the

Plate 28. Submerged Cultural Resources Unit Archeologist Larry Murphy operating Motorola Mini Ranger III positioning system and magnetometer aboard survey vessel Nick during second field session.

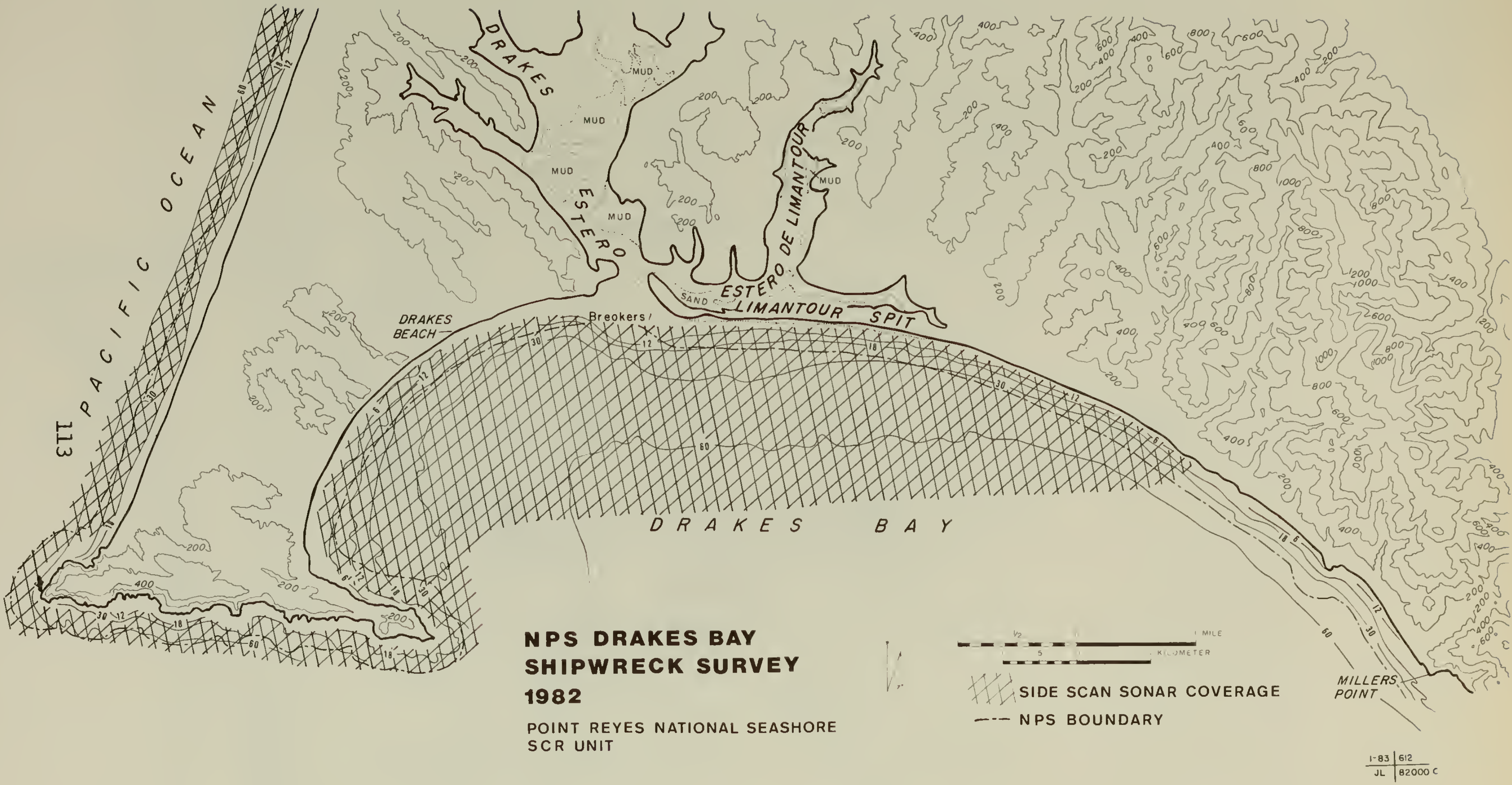


Figure 11. Side Scan Sonar Coverage Completed in Drakes Bay and Headlands Area During 1982 Survey

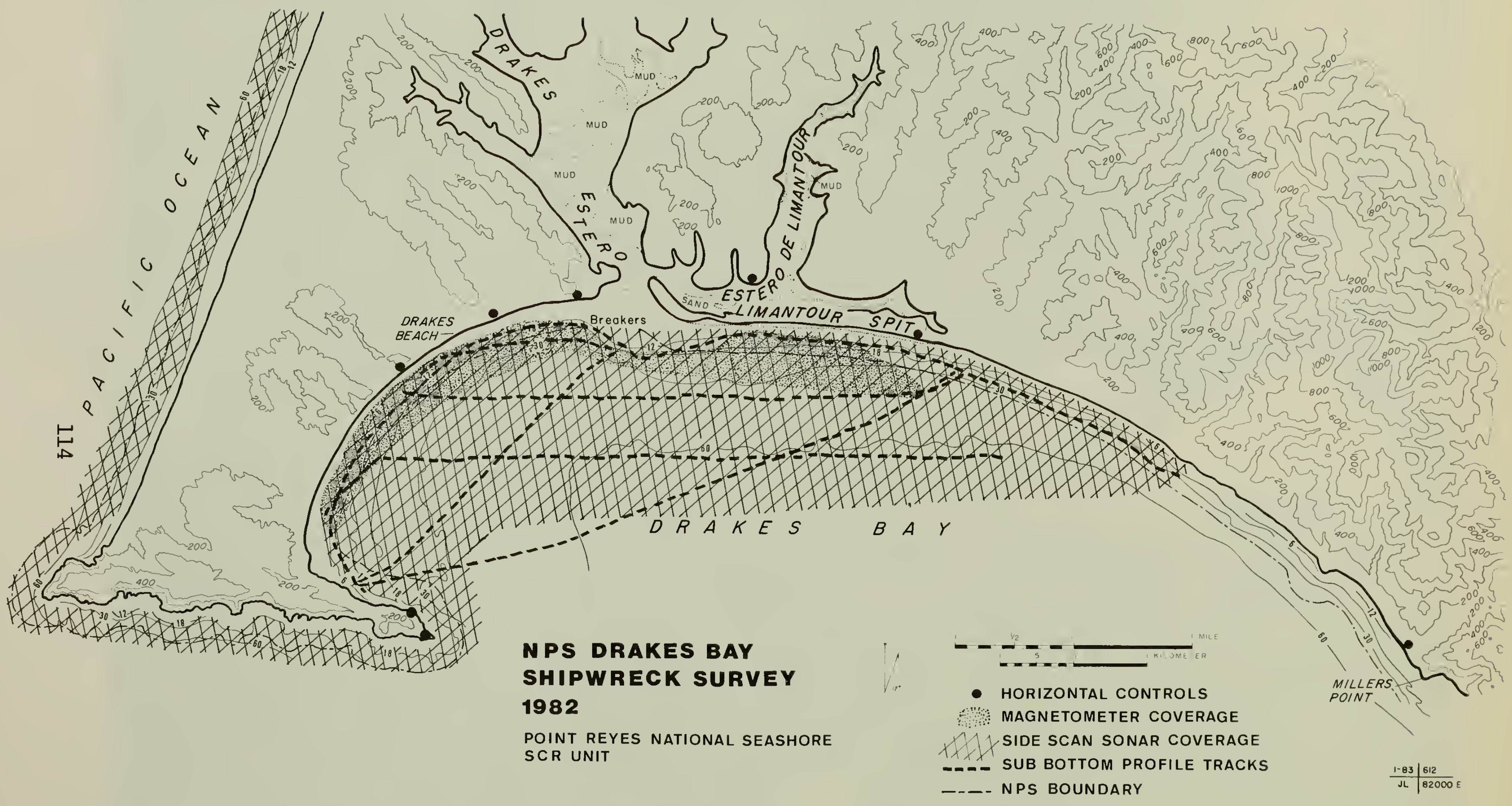


Figure 12. Remote Sensing Coverage of Survey Area Completed During 1982

remaining runs included only the magnetometer and sub-bottom profiler. The survey vessel was electronically positioned during all runs by the Mini Ranger III Positioning System aboard the survey vessel (Plate 29). The positioning data were stored on magnetic tape and a 3-5 second sample was printed out on the computer terminal. Periodically, at random intervals, a numbered position was executed on the terminal and the remote sensing instruments were manually event-marked to coordinate with the event number of the positioning equipment to allow accurate plotting of the profile data.

Results

The result of Phase I reconnaissance survey field work is the number of maps produced, representing the location of probable cultural materials. Magnetometer data are usually presented in a format that indicates location, intensity and, ideally, duration of magnetic anomalies. Side scan data are anomaly locations and reproductions of images of high-probability contacts. These data presentations are most useful for planning the Phase II testing and evaluation of areas indicated to contain cultural materials by the remote sensing instruments. Negative data allow areas to be removed from further consideration for impact and protection purposes.

Magnetometer

Five survey blocks were surveyed in 30-meter lane-spacing transects. Area I was the first area surveyed, and represented a high-probability area for wreck occurrence from analysis of available historical and physical data.

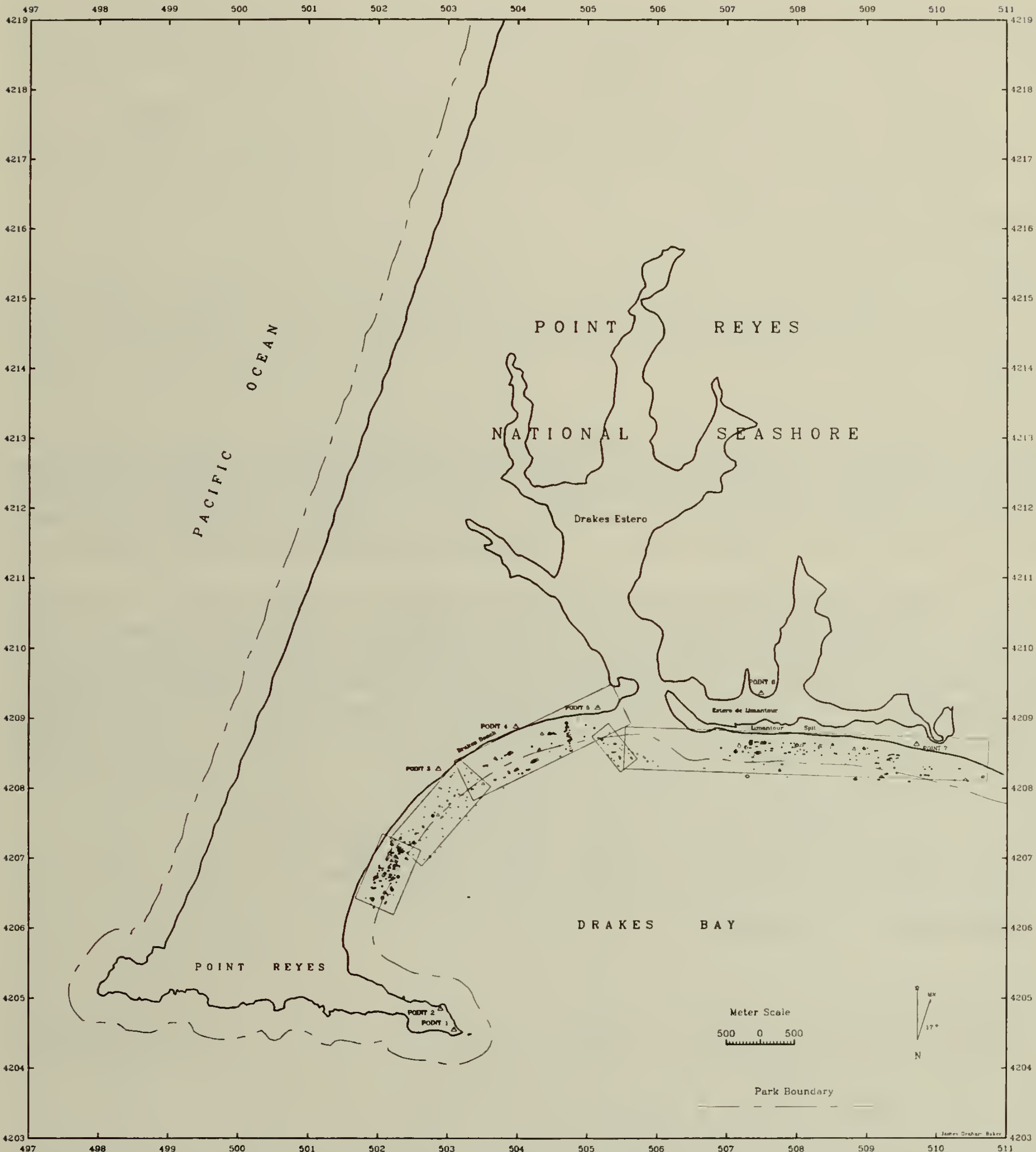
A total of 6.5 square kilometers (2.5 square miles or 1,600 acres) were surveyed by magnetometer (see Figure 10 above). This comprises a sample fraction of 18.5% of Drakes Bay above the 38th parallel. There were 684 anomalous readings recorded, which can be grouped into more than 300 discrete anomalies. Anomaly locations are positioned to scale on computer-generated maps. 1:500 scale maps were produced of each survey area, with symbols representing ±4, ±5-9, ±10-14, ±15-20 and ±20+ gamma readings plotted on their corrected position of occurrence. Correction factors for sensor cable length (layback) from the receive-transmit positioning station aboard the survey vessel were calculated. A general, large-scale anomaly concentration map of the entire survey area was produced, Figure 13.

The small-scale maps of individual survey areas have been analyzed, and anomaly clusters grouped and indicated. These maps are available to park and Western Regional Office staff, and will be the basic planning instruments for any Phase II activities.

The grouping of anomalies into clusters is based on the probability that close-proximity anomalies may be related.

Plate 29. Local fishing vessel Nick used as the survey vessel during the second field session. The magnetometer sensor is being deployed. The pontoons off the starboard support the sub-bottom profiler sensor and the side scan sonar towfish can be seen on the stern.

DRAKES BAY SHIPWRECK SURVEY
NATIONAL PARK SERVICE 1982



ANOMALY INTENSITY · = OR BETWEEN ±4 GAMMAS(γ) • =5 TO 9, OR −5 TO −9γ △ =10 TO 14, OR −10 TO −14γ
• =15 TO 19, OR −15 TO −19γ ○ =OR GREATER THAN ±20γ

Figure 13. Anomaly Distribution of 1982 Study Areas

Based on the target mass projections discussed above in the design section (454 kilograms, 1,000 pounds) priority was given for single anomalies in the 10-gamma range, the minimum reading expected from an object of target size. Anomalies were clustered together if they were detected on two consecutive transects. If a survey lane with no anomalies detected was run between two anomalies, they were considered separate. Anomalies in a north/south proximity of 30 meters (lanes were roughly east/west parallel to shore) were clustered, those of 60 meters separation were not.

Anomalies that occurred in a linear configuration on a single lane were clustered if they were closer than 15 meters. The survey vessel maintained a speed of 5-6 knots during the survey. The cycle rate of the magnetometer was set betwen 1 and 2 seconds. This gave a sample frequency of once every 3 meters (10 feet).

The positioning system recorded a vessel position every second. Every anomalous reading received a separate plot; thus an anomaly that had a duration of more than one second received a discrete symbol of intensity plotted in accurate location for each second of duration. This procedure enabled the anomaly intensity and duration longer than one second to be portrayed for analysis.

Anomaly clusters were numbered in a mechanical fashion in each area to enable planning for the priority order of testing. Single low-intensity anomalies will be listed, and a random sample will be established for priority of non-cluster anomaly testing. Ideally, all anomalies would eventually be tested, however, this procedure will allow testing of highest priority areas as funds become available. The establishment of a prioritized testing program will produce cost-effective data and returns, and will allow a constant monitoring of progress in the long-range anomaly evaluation program. All results will be cumulative and repetition of field work should not be necessary.

The survey areas produced the following number of clusters:

Survey Area	Clusters
1	7
2	9
3	18
4	13
5	2

Study area 2 must receive different evaluation for clustering anomalies. Anomaly readings and positions were recorded every 10 seconds instead of every one second. Original magnetometer data for some of the lanes surveyed in this area were stolen along with the camera equipment and the bag in which they were

being transported. Single anomalies in this area will receive a higher priority for testing than single anomalies of the other study areas. This is necessary because a single anomaly recorded may be the only representation for a cluster.

Limantour Spit was surveyed on foot for indications of cultural materials. Wood and metal objects, some of which were attributable to shipwreck materials (e.g., Plate 30) were observed.

In order to establish the potential for buried materials deposited on beach and dune areas, a brief and limited terrestrial magnetometer survey was carried out during the first session of the survey, concurrent with the marine survey (Plate 31). Some positive indications were observed, although no excavation or other testing took place. Further terrestrial survey and testing were indicated from these field operations. It was believed at the time that there existed high potential for buried shipwreck remains.

The erosions from the heavy winter storms of 1982-83 uncovered shipwreck remains on Limantour Spit. These were documented by personnel from Point Reyes National Seashore, Golden Gate National Recreation Area, Western Regional Office and Volunteers-in-Parks (Plate 32). Some of the results of this examination are included in this report as Appendix II.

The established presence of shipwreck materials in the beach and dune areas of Drakes Bay offers an opportunity for a continuous project involving volunteers and park personnel that would need minimal commitment of funding. Terrestrial magnetometer survey and anomaly testing could be carried out during most weather conditions and produce valuable documentation of the maritime resources of the park.

Side Scan Sonar

Twenty-six square kilometers (10 square miles) of side scan sonar were done in this area (13.5 square miles) of zone 2 within Drakes Bay (Figure 12). This produced a sampling fraction of 74% coverage. Approximately 7.7 kilometers (3 square miles, 1,970 acres) were completed in zone 3 along Point Reyes headlands and Point Reyes Beach.

Examination of the side scan records of the bay area produced no contacts immediately attributable to intact vessels or large vessel structures. The survey accomplished what was intended. However, the limitations of a survey of this nature became clear. The loss of resolution and the large scale produced by side scan sonar survey on 300-meter land-spacing, yield results of limited utility. It is difficult to determine accurately what would be visible and what would not, on this record. Large, intact vessels would likely not be missed, but smaller structures might. In an active environment, like that of Point Reyes, shifting bottom sediment may expose smaller and more fragile structures.

Plate 30. A steam superheater or preheater located on the north shore of Limantour Spit.

Plate 31. National Park Service Archeologist Ron Ice supporting terrestrial magnetometer sensor during brief examination of Limantour Spit during the first field session.

Plate 32. Volunteer-in-Parks Gregory Brown assists in the measurement of Pomo remains exposed on Limantour Spit by the winter storms of 1982.

Plate 33. Navy stockless type anchors on Munleon.

Plate 34. Point Reyes Ranger Russ Lesko examines the triple-expansion engine of <u>Munleon</u>.

Plate 35. Shaft tunnel of <u>Munleon</u>. The propeller shaft is in foreground.

Recommendations for side scan deployment in future surveys would be to include very high-resolution side scan runs on the narrowest feasible slant range with the magnetometer survey. Following this procedure, there should be little question about the presence or absence of most any cultural materials extant above the bottom in the targeted survey area. Although one can say with a high degree of confidence that no large intact wrecks are present in Drakes Bay, there is little indication of smaller vessels and structural elements.

The survey in zone 3, the headlands and Point Reyes Beach area, produced two distinct, positive contacts. Investigation of these by divers produced the wreckage of Munleon and Hartwood.

One dive was made on Hartwood. Wave and surge conditions precluded all but a cursory examination and identificaiton.

Munleon was examined more extensively. A sketch map was completed and photographs of features were taken (Plates 33, 34, 35). Two boilers, the engine, shaft tunnel and propeller shaft were recorded. This site is a priority for further documentaiton and evaluation. Munleon may prove to be an attraction for diving visitors to Point Reyes. Documentation should be directed to determining the extent and preservation of the site and its historical significance, prior to receiving any heavy diver use.

Hartwood should be further documented. This may be difficult, considering the water conditions. The site area should be monitored so that a dive team can be mobilized by the park when acceptable conditions are present.

The Geology Beneath Drakes Bay

Both the deep geologic framework and the near-surface geology beneath Drakes Bay can be described by the interpretation of sub-bottom acoustic reflection data. Two surveys using different sound sources were used for this study. A 1973 U.S. Geological Survey investigation combined the simultaneous use of a shallow-penetration, high-resolution Uniboom (tm), described above, and a deeper penetration, lower-resolution sparker. When used in conjunction with the 1982 National Park Service-U.S.G.S. Uniboom data collected for the shipwreck survey, the geologic interpretation can be extended to near-shore parts of the bay that were too shallow for the vessel used for the earlier survey. Tracklines of these combined surveys are shown on Figure 14. The following discussion considers both the deep geologic framework and the near-surface geology.

Geologic Framework: Seismic profiles reveal an east-west trending sub-surface ridge, or structural high, that crosses Drakes Bay (Figure 15). The ridge is expressed as the Mendoza anticline on the west shore of Drakes Bay on the Point

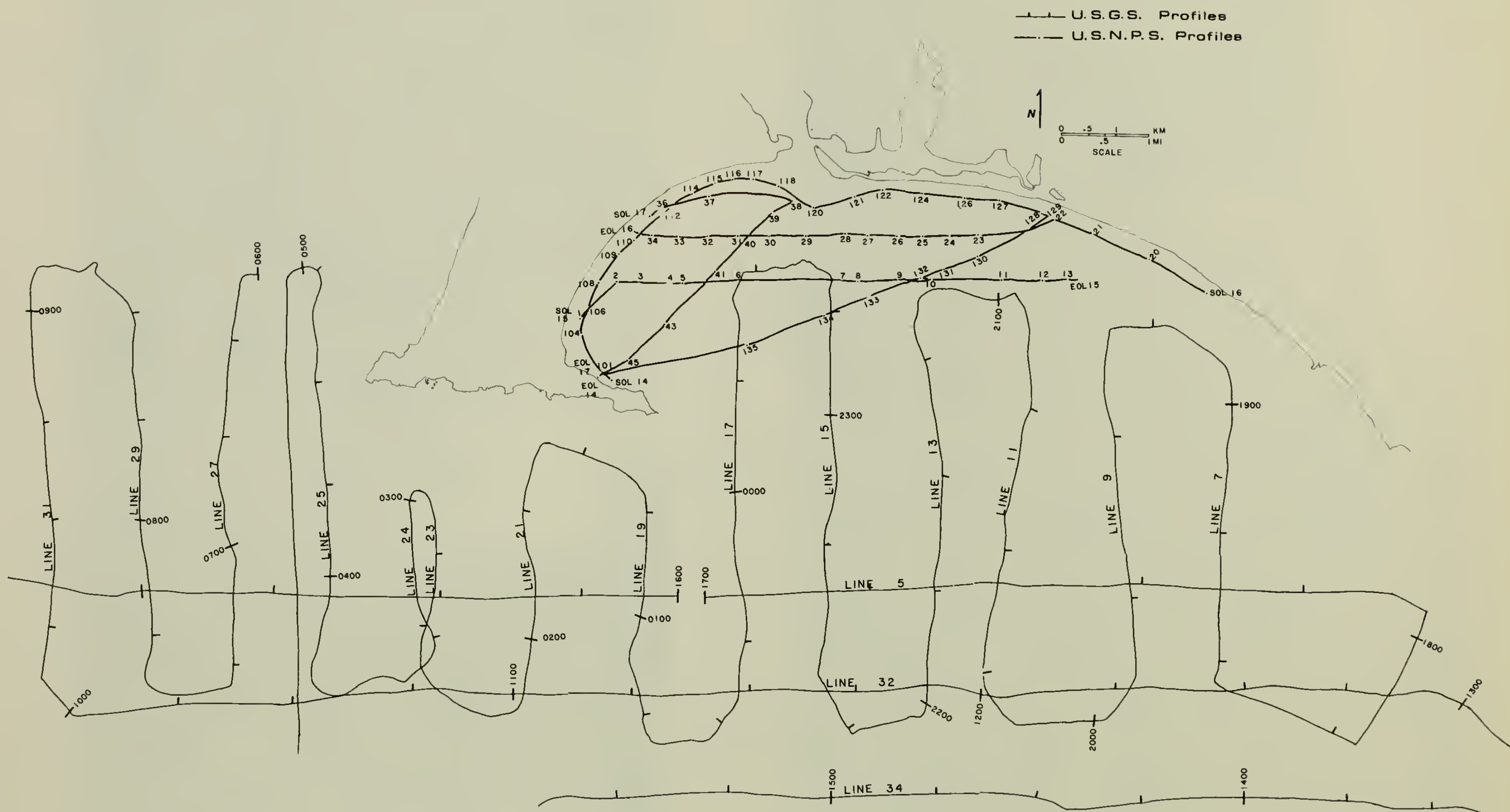


Figure 14. Track Lines of Acoustic Seismic Reflection Profiles in Drakes Bay and Adjacent Gulf of Farallons

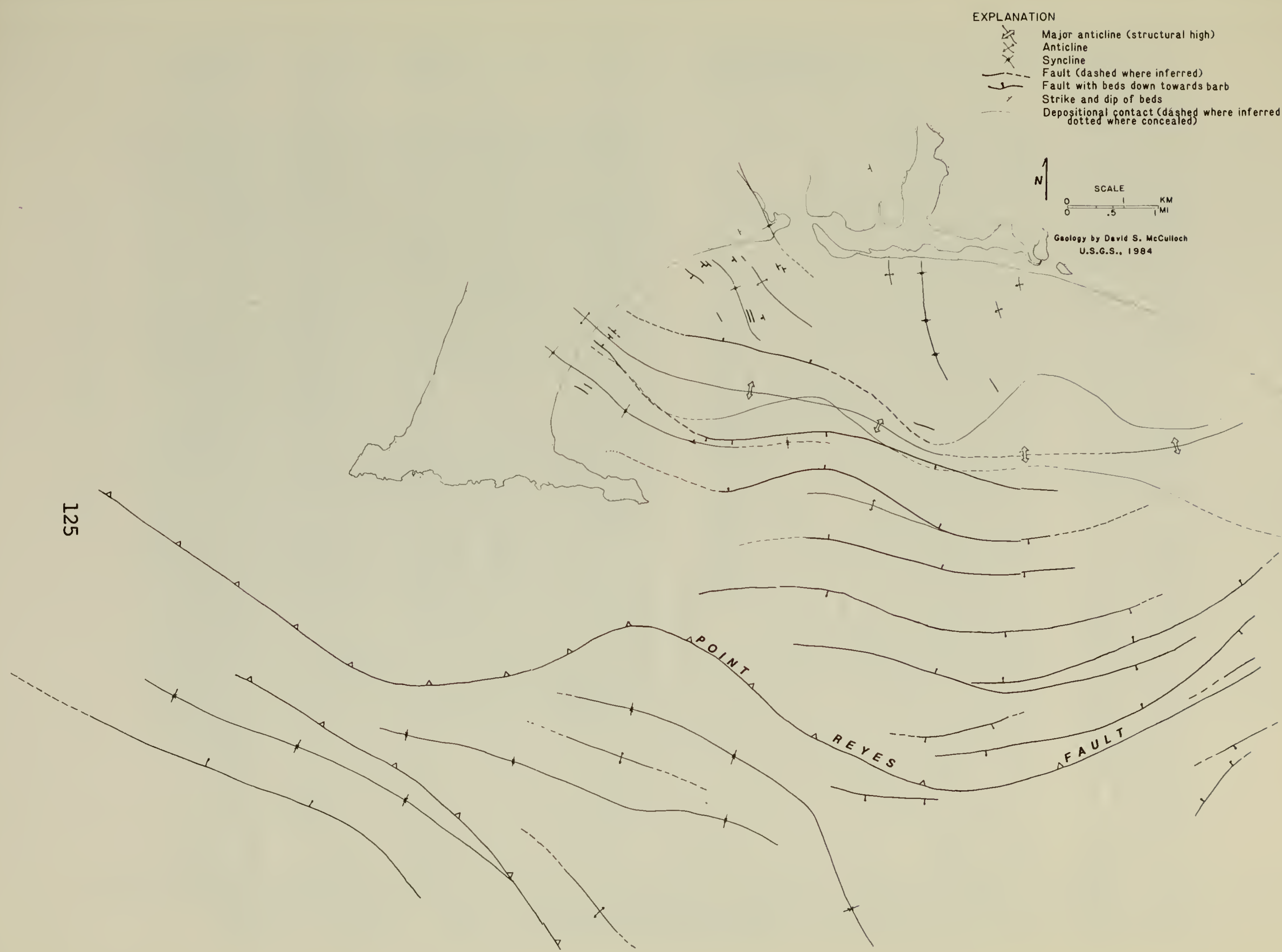


Figure 15. Map of Geologic Structures Beneath Drakes Bay and Adjacent Gulf of Farallons

Reyes Peninsula, where a 1951 exploratory well (Standard Oil, Mendoza No. 1) drilled on the anticline encountered the granitic basement rocks at a depth of 854 feet (Galloway 1977). The acoustic character of the subsurface ridge as seen on the deep penetration records (highly reflective upper surface and lack of internal reflections) suggests that the subsurface ridge may also be granite (Figure 16).

The granitic rocks of the Point Reyes Peninsula are the exposed basement rocks of the Salinian block, which in this area is bounded on the east by the San Andreas Fault and in the offshore by a fault that lies along the west side of the Farallon Islands. These basement rocks that form the foundation for the Point Reyes Peninsula have had a long and poorly known history. The age of the granitic rocks (Cretaceous age, 80-100 million years Before Present [B.P.]) is known by radiometric dating, but neither their place of origin, nor the trajectory they have followed from their place of origin is well established. Originally thought to have come from the south end of the Sierra Nevada batholith, it is now suspected that they may have originated several thousands of kilometers to the southeast (Kistler and Peterman 1973:1970). As these granitic rocks and blocks of other geologic terrains were transported northwestward by strike-slip faulting along the continental margin, the blocks were sheared and folded. Occasionally they were elevated above sea level and subjected to erosion, or submerged to become the repositories for the accumulation of marine sediments.

The post-Cretaceous history of this block, as interpreted from the kinds of rocks now exposed on the Point Reyes Peninsula and their structure and stratigraphic relations (Clark et al. in press; Galloway 1977), suggests the following brief outline for the major geologic events:

1. A period of erosion during which the granite that originally was below the surface of the earth was exposed by the removal of the overlying rocks.

2. A period of marine submergence accompanied by the deposition of a coarse marine conglomerate of Paleocene age on the exposed granitic rocks. This conglomerate, which contains a few coarse granite clasts, is the Point Reyes Conglomerate that outcrops on Point Reyes.

3. Probable emergence and accompanying erosion of marine sediment of Eocene age that are reported in nearby offshore exploratory drill holes (Hoskins and Griffiths 1970), may also have covered the Point Reyes Peninsula.

4. Submergence below a Miocene sea. As the encroaching sea crossed the rocks of the Peninsula, it deposited a shallow water transgressive sand (Laird Sandstone). This was followed by deep water deposition of the fine-grained sediments of the Monterey Formation of middle and late Miocene age. These

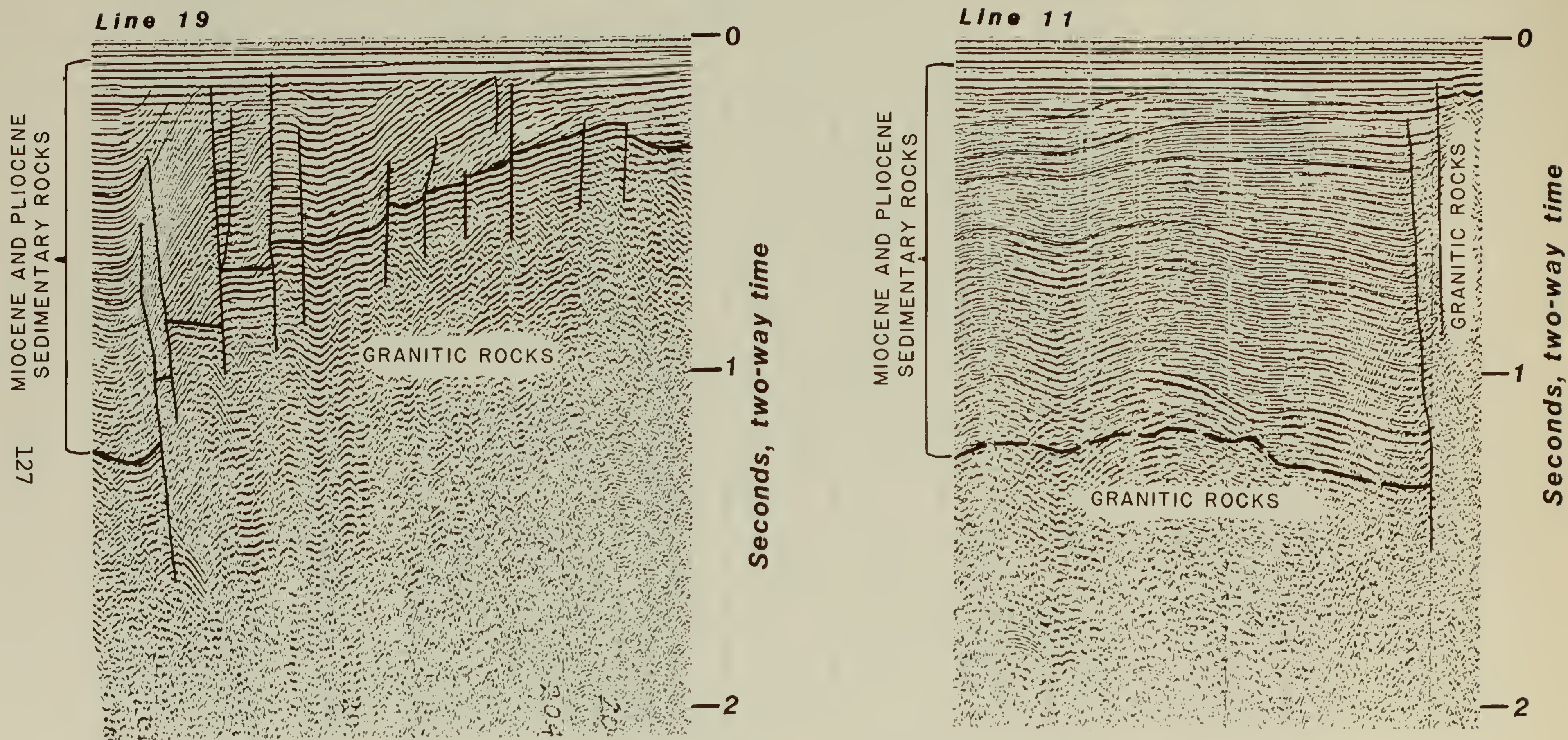


Figure 16. Interpretations of Deep Penetration Sparker Profiles. Track lines are indicated in Figure 14 (north to right). Note the large vertical offset of the granitic rocks along the easterly-dipping Point Reyes Fault. Vertical exaggeration is approximately 3 to 1.

rocks crop out on the northeastern half of the Point Reyes Penisula and extend as far east as the San Andreas Fault.

5. A period of structural deformation which faulted and folded both the granite and the overlying Monterey Formation. Deformation was accompanied and followed by erosion that removed the Miocene rocks from the southwestern part of the peninsula.

6. The area was again submerged and marine sandstone, siltstone and mudstone (Santa Margarita Sandstone, Santa Cruz Mudstone and Purisima Formation of siltstone, mudstone and sandstone) were deposited sequentially from late Miocene to Pliocene time.

7. Emergence above the Pliocene sea and subaerial erosion that left Pliocene-aged rocks only on the southwestern part of the peninsula.

Over the long term the Salinian terrane, which underlies the Point Reyes Peninsula, has been carried to the northwest along strike-slip faults. However, during the early part of the history described above, strike-slip displacement gave way to regional compression and lateral shearing that accompanied the oblique subduction of the Farallon oceanic plate beneath the edge of the continent. Subduction in this area lasted until possibly Miocene time when it was replaced by renewed strike-slip motion along the San Andreas and related offshore faults. By correlating the Miocene and Pliocene sedimentary rocks on the Point Reyes Peninsula with similar rocks to the southeast on the other side of the strike-slip faults, it has been estimated that Point Reyes has moved a possible 150 kilometers during the last 11-12 million years, and that 70 kilometers of that movement occurred during the last 6 to 6.5 million years (Clark et al. in press). Movement along the San Andreas Fault is not the only young faulting to affect the Point Reyes area. Just offshore of the southern end of Point Reyes, and following a somewhat sinuous path across the mouth of Drakes Bay, is the Point Reyes Fault which Hoskins and Griffiths (1971) originally mapped as a high-angle reverse fault (Figures 15 and 16). Movement on the fault has considerably uplifted rocks on Point Reyes relative to rocks across the fault to the south.

For example, granitic rocks are exposed at Point Reyes, but in two offshore exploratory wells (Shell P-041-1ET, Shell P-039-1ET) drilled on the south side of the Point Reyes Fault, approximately 6 kilometers to the southeast and 6 kilometers to the southwest of the point, granitic rocks were encountered at depths of 1,432 meters (4,700 feet) and 1,717 meters (5,632 feet). In the offshore wells, the sequence of marine strata and their stratigraphic relations (Miocene Monterey Formation separated from overlying late Miocene and Pliocene-aged sedimentary rocks by an erosional unconformity) are similar to the now-elevated rocks exposed on the Point Reyes Peninsula. These similarities indicate that the two areas share a common geologic history and

that they were at about the same altitude, with respect to sea levels, possibly throughout Miocene and part of Pliocene time. On the south side of the fault, beds of upper Pliocene age (Hoskins and Griffiths 1970) lie against the fault, whereas much of the Pliocene section has been eroded from the peninsula. It seems probable that the vertical displacement that elevated Point Reyes and initiated the erosion is of late Pliocene or early Pleistocene age.

In nearby onshore areas, there is considerable evidence for a late Pliocene-early Pleistocene tectonic episode (Pasadenan orogeny) of major importance that was typified by large vertical displacements. Most of the major physiographic features of our present landscape were developed during this deformation. The highlands that existed beneath what is now San Francisco Bay and the Santa Clara Valley sank to become structural troughs, and the troughs that originally lay adjacent to these highlands were uplifted to form the Berkeley Hills and Santa Cruz Mountains (Christensen 1965). Within the Salinian block, high angle reverse faults, like the Point Reyes Fault, were the predominant kind of fault along which the vertical displacements occurred (page 1966). Thus, although modified by some younger tectonic deformation, the present physiography of the Point Reyes Peninsula is largely the result of a very young late Pliocene-early Pleistocene orogenic event.

As shown on the structure map (Figure 15), the structural high in Drakes Bay and its associated folds and faults exhibit a sinuous pattern. Part of the somewhat greater sinuousity in the Point Reyes Fault is attributable to the dip of the fault plane, but the fact that all structures show a somewhat similar distortion indicates post-folding post-faulting deformation. The fold pattern suggests that the elevated granitic rocks beneath Point Reyes may have acted as a buttress against which some compressive component developed the younger deformation. The impression that Point Reyes acted as a buttress is also suggested by the fact that the Point Reyes Fault and adjacent folds wrap around the western side of Point Reyes and assume a northwest trend parallel to the regional structure (McCulloch et al. 1980).

The age of the most recent movement of the Point Reyes fault is not firmly known. However, two epicenters have been located along the fault. One lies approximately 10 kilometers southeast of the point, the other lies approximately 45 kilometers from the point along the northwestern part of the fault. If these epicenters are correctly located, the fault may be seismically active.

<u>Near-Surface Geology</u>: The high resolution, seismic-reflection profiles reveal a relatively complete record of the recent geologic history of Drakes Bay. Deposits associated with these events are shown on a diagrammatic cross section (Figure 17) and their aerial distribution are shown on Figures 18-20.

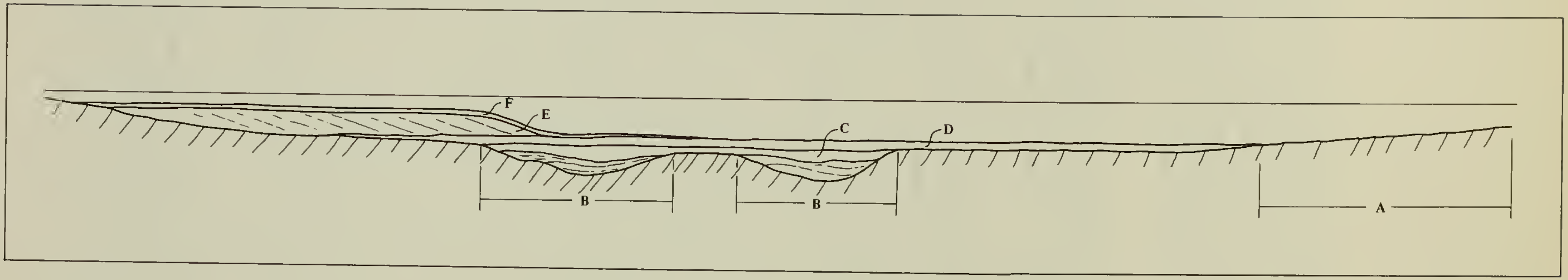


Figure 17. Diagrammatic East-West (West to Left) Cross Seciton of the Young Geologic Features Beneath Drakes Bay. Letters refer to surfaces in deposits described in the text and indicated by the letters on Figures 18-20.

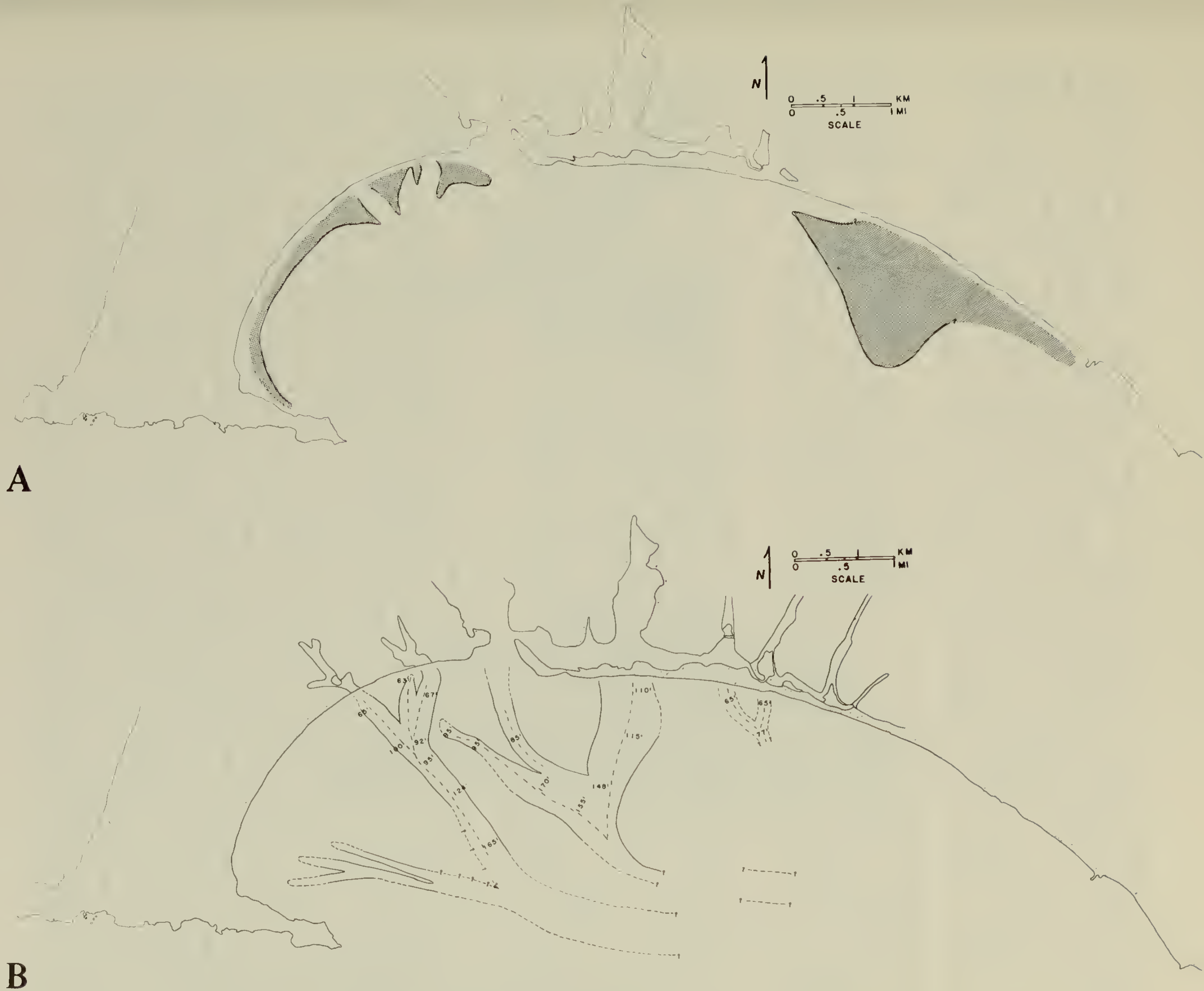


Figure 18A. Shaded Areas Indicate Where Bedrock is Exposed or Very Close to the Bay Floor

18B. Paleodrainage Channels Cut into Bedrock. Depths of the thalwegs (the deepest part of the channel) are given in feet below sea level.

Cut into the bedrock floor of the bay are stream channels, many of which appear to join subaerial valleys (Figure 18B). The largest and deepest of the channels is the offshore extension of Drakes Estero. The tributaries join near the middle of the present bay and the major offshore channel appears to have flowed to the east. Depths below sea level of the channel thalwegs show some depth reversals, suggestive of pools and riffles of subaerial drainages. Within these channels are what appear to be minor cut and full deposits with cross-channel dips which suggests that they are stream channel deposits.

Overlying the channel deposits is a seismic reflection unit (unit C, Figure 17) that indicates deposition of a sedimentary deposit that filled the upper reaches of the channels and flooded over the interfluvial drainage divides of the lower stream courses. This depositional distribution suggests an estuarine to marine interval during which the river channels aggraded in response to a relative rise in sea level (Figure 19C).

Lying everywhere above this unit is a blanket deposit that covers most of the present bay floor (Figure 19D). This is probably a fully marine transgressive unit. Its distribution suggests that, by the end of its deposition, the area of the modern bay was submerged and that the shoreline lay near its present position. In some places this unit forms the modern bay floor. Because the base of this deposit represents a transgressive interval, the grain size of the sediment within the unit may fine upward toward the surface. Grain-size analyses of samples collected from the top of this unit, where it is exposed on the sea floor, indicate that it is composed of fine sand with a size range of 150-200 microns (Cherry 1964).

Resting on this marine unit along the western side of the bay is a 10-15 meters thick deposit with a flat top and foreset bedding that suggests that it prograded away from the shoreline over the older marine unit (Figure 20E). The prograded deposit can be seen on seismic-reflection profiles to encircle the Point Reyes Point (McCulloch et al. 1980). Within Drakes Bay, the steep depositional front of the prograded unit loses relief as it swings to the northeast around the point. The top of this unit lies approximately 15 to 18 meters below sea level, too deep to be affected by longshore currents generated by swells, but not too deep for swells to entrain bottom sediment that might then be transported by some other mean flows. It is possible that this deposit is composed of sediment transported to the south along Point Reyes Beach that is now being carried around the point by mid-shelf currents. It is also possible that this prograded deposit was constructed during a somewhat lower stand of sea level; possibly one of the sea level fluviations that occurred during the last general rise in post-glacial time. A somewhat similar but aerially restricted deposit is found on the northeast side of the bay (Figure 20E). This deposit also appears to be a prograded beach.

C

D

Figure 19C. The Distribution of a Possible Estuarine Deposit that Filled the Paleo Channels and was Deposited by the Interfluves Along the Lower Stream Courses

19D. The Distribution of a Blanket-Like Deposit that is Probably Fully Marine, and Represents the Most Recent Post-Glacial Marine Transgression

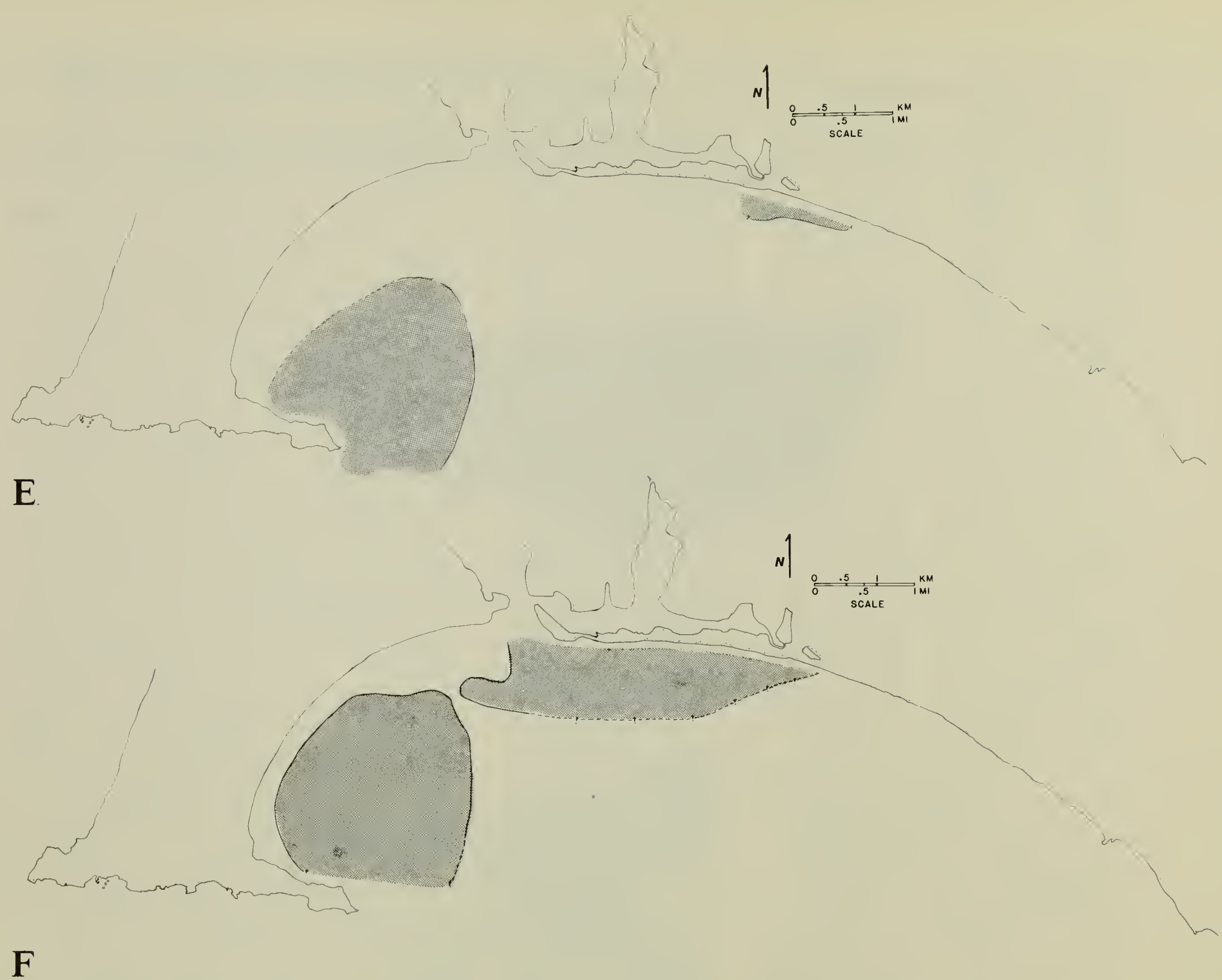


Figure 20E. The Distribution of Prograded Sedimentary Deposits That Overlay Stratum D. Small eastern deposit may represent modern beach material. The larger western deposit is composed largely of coarse sediment derived form marine erosion of the south-facing, wave-cut cliffs of Point Reyes. The deposit extends to the west along the south face of the Point. Only the pay deposit is shown.

20F. The Distribution of Top-Set Beds That Lie on Strata D and E

Overlying the offshore-dipping strata of the prograded deposit on the west side of the bay is a thin 3 to 4 meter thick horizontal unit that probably represents a topset deposit of sediment (Figure 20F). Surface samples from this deposit range from 200 microns at the toe of the deposit to 660 microns nearer shore on the top of the deposit, that is, from medium to coarse sand (Cherry 1964). From a consideration of the heavy mineral assemblage, Cherry (1964) concluded that this deposit is largely composed of material eroded from the south-facing cliffs at the point, and that very little sand from Point Reyes Beach is being transported around the point. At its northeastern edge, the prograded unit thins and the topset beds are deposited across the thin edge and directly upon the underlying marine blanket. Shown with the topset unit on Figure 20F is the distribution of a thin sedimentary unit that lies upon the marine blanket along the northern edge of the bay. The topset sediment and this sedimentary unit on the north side of the bay are the most recent bay floor deposits recognizable on the seismic profiles.

Before summarizing the recent geologic history of Drakes Bay, mention should be made of the elevated coastal terrace that indicates geologic events that predate events recorded on the bay floor. Minard (1964) and Galloway (1977) describe a coastal terrace cut into bedrock that can be traced for about 6.5 kilometers eastward from the base of Limantour Spit. At its southeast end near Bolinas, the bedrock cut surface (the Bolinas-Drakes Bay terrace) stands approximately 40-60 meters above sea level. To the northwest, the bedrock-cut surface becomes lower and finally disappears beneath the modern beach about 1-1/2 kilometers east of Limantour Spit. However, the bedrock-cut surface is covered by an alluvial gravel that thickens to the northwest and reaches a maximum thickness of about 30 meters. Near its western end, E. Clifton (USGS, written communication 1984) reports a small prism of marine sediment about 1 meter thick that locally overlies the wave-cut platform and is overlain by the alluvial gravels. Galloway (1977) atrributes the wave-cut bedrock terrace to erosion during a Pleistocene high sea level stand and suggests that the terrace has since been tilted by tectonic deformation.

A summary for the Pleistocene and recent (Holocene) events at Drakes Bay is as follows:

1. Development of an apparently once extensive sea-floor erosional surface on the bedrock during a Pleistocene sea level stand. The elevated wave-cut terrace is a remnant of this sea floor. If this high terrace was cut during the last Pleistocene high sea level stand, it should be approximately 125,000 years old (Shackleton and Opdyke 1973).

2. Sea level was lowered and the area was tectonically deformed, as indicated by the tilted wave-cut terrace. Tilting may have accompanied regression of the sea because the land-laid deposits that overlie the wave-cut terrace thicken to the northwest above the wave-cut surface suggesting that the

land-laid terrace deposits may have been graded to a shoreline not parallel to, and at some distance from, the wave-cut bedrock terrace.

3. A period of subaerial erosion during which stream channels dissected the peninsula and the present bay floor. Barring local tectonics, erosion of the bay floor would have been initiated with the lowering of sea level from its high stand 125,000 years ago and would have continued until rising sea level returned to flood the bay. The deepest channel thalweg recorded beneath the bay lies at about 55 meters below sea level. As the sea rose to its present level in post-glacial time, a rapid rise that started about 18,000 years ago, it reached a depth of 55 meters below present sea level approximately 12,500 years ago (Shackleton and Opdyke 1973), hence the drainage network now submerged beneath the bay was well developed 12,500 years ago.

4. With rising sea level, the channels were subjected to tidal flows and may have become estuarine and, at a present depth of about 27 to 30 meters below sea level, the possible estuarine deposits overflowed the old channels and were deposited on the interfluve areas.

5. The rising sea swept ashore over the estuarine deposits leaving a blanket transgressive deposit about 5 meters thick over most of the present bay floor.

6. Coastal erosion on Point Reyes Beach, and possibly Point Reyes, contributed sediment to a prograded deposit that surrounds the point and protrudes into the western edge of the bay. It is not known if this deposit resulted from deposition during a temporary still stand of sea level during the rise from the last glacial low sea level, or from modern mid-shelf sediment transport.

7. Coastal transport carried coarse sediment eroded from the cliffs at Point Reyes into the northwestern part of the bay as a topset deposit across the prograded deposit that surrounds Point Reyes.

8. Along much of the shoreline, the waves are cutting into the bedrock coastline. On the eastern side of the bay, waves have cut an extensive terrace across the bedrock exposed on the bay floor.

With the present level of information it is difficult to securely date the geologic events indicated by this sequence. Probably the aggradation of the now submerged river channels and the ensuing marine deposits represent the most recent post-glacial rise in sea level. However the close proximity of the Point Reyes Fault, which has experienced considerable vertical displacement in relatively recent geologic time, also suggests the possibility that part of the history might be due to continued fault displacement. For example, uplift on

the north side of the fault might have raised Drakes Bay above sea level, exposing the bay floor to a period of subaerial erosion represented by the now submerged river channels, rather than erosion having been initiated by a wide-spread glacial lowering of sea level. However, the principal evidence for local tectonic deformation appears to be the tilting of the old wave-cut bedrock Bolinas-Drakes Bay terrace, and although local tectonics may have had some minor effect, the presence of the elevated wave-cut terrace, the period of erosion during a following low sea level stand and a recent rise in sea level indicated by the deposits on the floor of the bay, is consistent with the world-wide late glacial and post-glacial sea level history.

With some additional work, primarily high-resolution seismic profiling, bottom and sub-bottom sediment sampling and radiometric dating, it would be possible not only to define the sedimentary units more accurately but also to reconstruct the age and conditions under which the units were deposited. This work would serve as a test of the suggested geologic reconstruction and might shed light on recent history of displacement of the Point Reyes Fault.

By using sediment thicknesses measured along the high-resolution profiles, it is possible to contour the thickness of the sediment resting on the bedrock floor of Drakes Bay. This contour map is shown in Figure 21. Actual thickness may be greater than indicated because the thicknesses were measured assuming that the sound traveled at the same velocity through the sediment as it does in water. Experience in San Francisco Bay, where acoustic profiles were run over bore holes, has shown that at that location, geologically-young fine-grained sediment transmits sound at approximately the same velocity as water. Errors produced by this assumption are probably small and within the resolving capability determined by the duration of the Uniboom acoustic pulse.

Conclusions

The survey has given a clear indication of the extent and location of potential historical shipwreck sites within Drakes Bay. The actual determination of what vessels are represented by the magnetic data and the evaluation of their significance is dependent on Phase II fieldwork. Future fieldwork should initially focus on test excavations of the priority clusters indicated for each survey block. Ideally, all anomaly readings would be tested, however, this is a lengthy and time consuming task which could not be justified in a management mileu when no impacts are intended. Hence, the development of a test excavation strategy, based on a priority approach, is necessary.

Clusters of anomalies are recognized as potentially representative of shipwreck sites and consequently should be the major focus of the program. However, isolated anomalies represent human activity as well. Patterns of use such as fishing, safe anchorage, salvage attempts and accidental loss are reflected in the distribution of discard materials which can be discussed by "ground

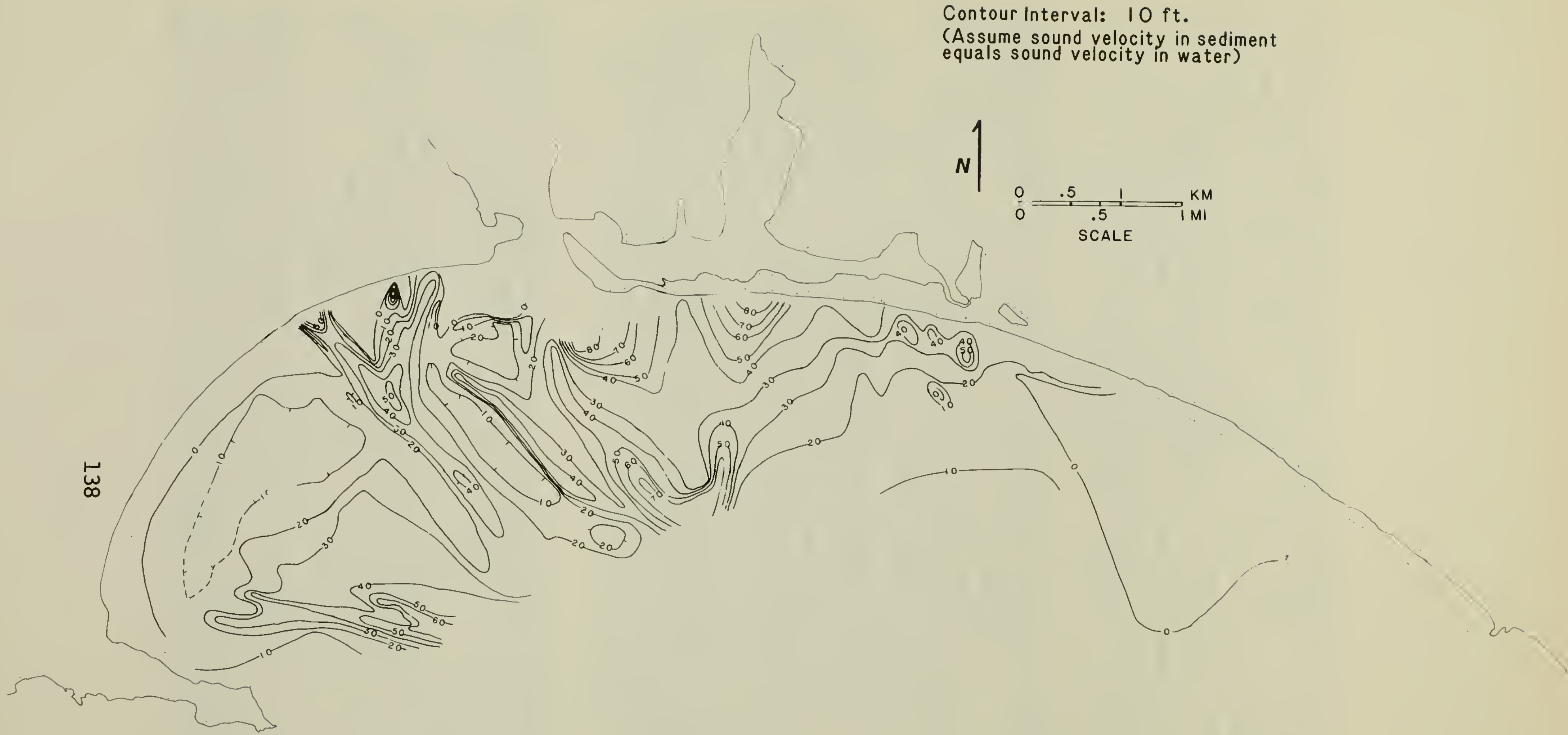


Figure 21. Contour Map of the Thickness of Unconsolidated Sediments Resting on Bedrock Beneath Drakes Bay

truthing" the single point anomalies. The approach to testing the non-clustered anomalies should be executed as a part of a specific sampling design formulated to contribute to the overall understanding of the activity of Drakes Bay in the regional context. This approach is new to underwater archeology and it has not been applied to any large scale project. Drakes Bay offers a superb test case and successful completion of the Phase II evaluation phase should make a major contribution to research as well as management needs.

The subsurface geological analysis has made a significant addition to the survey results. The sediment-overburden depth information makes it clear that the test excavation instrument of choice will be the prop wash deflector, currently the only instrument capable of efficiently removing sediment depths in the magnetically surveyed area. Only sterile sediment will be removed with this device. More easily controllable tools such as airlifts and dredges will be used for excavation of strata bearing cultural material.

The detailed subsurface geological analysis has raised an important point for consideration. As a result of the geologic history, there is a real possibility of locating early prehistoric terrestrial sites in the areas of inundated stream channels and within the area behind Limantour Spit. Drowned terrestrial sites result from sites that were inhabited at a lower sea level stand being inundated by the rise of the sea to the modern level. Inundated sites from the earliest periods of human occupation have been recognized in North American, including California (Cockrell 1980:136-145), and their presence offer remarkable research potential. Therefore, all test excavations on magnetic anomalies will be carried out with procedures capable of identifying inundated and buried terrestrial archeological sites.

The Phase I survey has accomplished the goal of locating potential historical shipwreck sites and has also provided the necessary basis on which to design Phase II evaluation fieldwork. The background historical research included in this report can be used immediately to enrich interpretive programs in the park and sanctuary as well as the region.

VIII. FIELD ARTIFACT CONSERVATION PROGRAM

From the inception of this project, there was concern that a conservator be available to monitor retrieval, transport and storage of artifacts. A professional conservator, Brigid Sullivan of the National Park Service, was consulted and a program instituted. The program consisted of three aspects: developing facilities and procedures for field conservation of artifacts recovered during the survey, training field personnel in proper procedures and data recovery, and preparing for the laboratory conservation of materials.

The equipment and facilities for the field conservation were procured and installed on location at the old Coast Guard station at Drakes Bay, the operational headquarters during the survey. Field personnel likely to be involved with artifact recovery were briefed and instructed in requisite field handling and environmental data recording techniques by the conservator. Field personnel were given a basic description of depositional variables and the effects of various physical and chemical processes on artifact preservation. Personnel also received specific transportation and storage instructions for the recoveries. This information, compiled by Sullivan, comprises the basic approach to the field artifact conservation program for the Drakes Bay shipwreck survey and is presented below in outline form (Ed.).

Drakes Bay Shipwreck Survey: Considerations for Field Conservation and Transportation of Artifacts

I. Additional information needed:

  A. Environmental data

    1. Description of what artifacts are buried in (depositional matrix).

      a. Rock - greatest chance of physical breakup.

      b. Sand - rapid deterioration due to physical erosion.

      c. Silt - generally good physical preservation, although there can be chemical problems related to silt burial.

      d. Clay - colloidal, can tightly bind objects, but usually, objects found on top of clay buried in sand or silt.

2. Aspects of micro-climate

   a. Sediment type - usually, large-pored sediments such as sand permit water movement and entrain oxygen; dense sediments such as silt are indicative of poor water circulation and are anaerobic, or oxygen poor.

3. pH - All salt water is slightly alkaline, pH 7.5-8.5, but pH is a geometric progression, and there can be great differences between points on this scale.

   a. Oxidizing atmosphere - Alkaline pH in range of sea water.

   b. Reducing atmosphere - Acidic pH in range of sea water.

4. Salinity is solid material, expressed in grams, contained in one kilogram of sea water when all carbonates are converted to oxides, all bromide and iodine to chlorine, and all organic matter is oxidized. Increased salinity can cause significant increase in galvanic corrosion and more rapid solution of carbonate and sulphate minerals. When a body of water is land-bound, or partially land-bound, the salinity tends to be greater, causing anoxic conditions (reducing-anaerobic).

5. Color of sediment - Light brown generally indicates oxidizing environment; grey or green to black generally indicates reducing environment.

6. Presence of organic material - Decomposition of organic matter produces organic acids, depletes oxygen, promoting presence of sulphate-reducing bacteria. Bacterial activity will be greatest in or on the sediment. This condition promotes growth of concretions.

B. Proximity of other metals or organic materials (associations). This is especially important for metals due to galvanic corrosion and preferential corrosion on the electrochemical scale of noble-to-base metals.

   1. Causes of concretions on metals

      a. Electrochemical

      b. Physiochemical precipitation

      c. Organic

Concretions should never be removed in the field. They form a physical barrier to the diffusion of oxygen, preventing the galvanic process (anodic/cathodic response to electrolyte), which results in active corrosion.

2. Proximity to organic material and organic decomposition. This proximity may help to explain deteriorated conditions of arti facts and differential preservation of artifacts, e.g., there is some indication that silver in association with iron may be galvanically protected.

   Iron concretions - Concretions are usually a result of very rapid corrosion of an iron artifact. The release of iron corrosion products into the water causes an increase in alkalinity and the rapid precipitation of calcium carbonate, which results in the growth of a concretion. This is a electro-chemical process. The increase in pH produced by the cathodic ions of iron causes the saturated calcium and magnesium present in sea water to precipitate on any cathodic surface, and forms a matrix for the adhesion of marine skeletal remains. Iron concretions can be found on metal containing no iron due to this response. Small artifacts can be trapped within a larger concretion.

   Concretions can also be physiochemical, and related to bacterial activity:

   Decomposition of organic matter

   Formation of organic acids and liberation of carbon dioxide

   Decrease in pH

   Dissolving of calcium from sediment, increasing the concentration of calcium in the sea water

   Initiation of sulphate reduction

   Increase of hydrogen sulphide

   Decrease, then rise to original pH

   Photosynthetic removal of carbon dioxide

   Further rise in pH

   Precipitation of calcium carbonate

II. Deterioration of Artifacts

A. Inorganic

1. Metals

a. Iron - Susceptible to sulphate reducing bacteria and electrochemical and physiochemical concretions. Composition of iron is important. Cast-iron is especially vulnerable to sea water and easily becomes infused with sodium chloride due to its porosity. Electrochemical process: salt water acts as an electrolyte and causes formation of ferrous chloride. When exposed to air, oxygen combines with ferrous chloride solution and rapid rusting occurs. This can mechanically break apart an object in very short period of time. Cast-iron is alloyed with manganese, phosphorous, and silicon. A high silicon alloy is somewhat more resistent to corrosion.

b. Copper/Copper Alloys

1) From reducing environment, usually covered with an iridescent blue-black covellite or chalcocite. It has a characteristic appearance of pitch rolled in sediment and broken shells.

2) From an oxidizing environment - Pale green paratacambite and red/purple cuprite (this corrosion prevents marine organisms from settling on the surface; hence, paints rich in copper compounds are usually used to paint boat hulls).

3) Bronze - Higher tin content is more resistant to corrosion.

4) Brass with high copper content is more susceptible to dezincification (characteristic graining, pink crystalline appearance) especially in oxidizing environment.

c. Silver

1) Conversion to black/shining silver sulphide in anaerobic conditions, but with no adhering sediment or shell particles.

2) In oxidizing conditions, no corrosion, good preservation due to formation of protective coating of silver chloride.

3) If silver is alloyed with base metals like copper, the base metal will preferentially corrode and cover the silver with corrosion products.

d. Lead

1) Will convert to black, brittle lead sulphide (galena) in anaerobic sulphide reducing environment.

2) In aerobic conditions it forms a protective coating of lead carbonate, usually good preservation.

3) Lead still in contact with organic material like wood will quickly revert to black lead sulphide due to decay and production of organic acids.

4) Lead/tin alloy (pewter, etc.) - Highly resistant to attack by sea water, but may have pitted appearance due to the preferential corrosion of lead to tin.

e. Gold - Because this is the noblest of metals on the electrochemical scale, it will remain in good preservation. If alloyed, there may be preferential corrosion of the alloy metal, but it will not significantly damage the gold.

2. Ceramics

a. Pottery is mostly damaged underwater by physical erosion of sand and the attack by marine organisms such as worms, crustacea, molluscs, barnacles, and algae.

b. If buried, pottery remains intact with good preservation (although this depends on sediment acidity and paste filler).

c. Because pottery is porous, it becomes infused with soluble salts. This is not a problem underwater where the salts remain in solution.

d. Lead glazed pottery becomes black by sulphate-reducing bacteria.

3. Glass

a. Will decompose or devitrify by the preferential leaching and diffusion of alkali ions present in the composition of glass.

Depth of burial in sea can increase the rate of diffusion of these ions.

4. Stone

   a. Deteriorates either by physical erosion or chemical solution.

   b. Sea water is usually less corrosive to stone because of the high calcium carbonate saturation, but diluted, under saturated harbor waters can be aggressive to stone. Salinity is usually higher in shallow land-bound areas, causing anaerobic conditions (acidic). Acidic conditions promote solution of carbonates and sulphates and physiochemical precipitation. Bacteria that produce organic acids can break up stone.

   c. Marble (limestone) and gypsum (alabaster) are most poorly preserved in sea water because of the solubility of carbonates and sulphate minerals.

III. Handling of Artifacts

IT IS EXTREMELY IMPORTANT THAT ALL OBJECTS BE KEPT WET AT ALL TIMES

A. Metals

1. Iron - When lifted, place in container of sea water on boat and wrap object with rags etc. for padding protection for removal to shore. When on shore, place object in 5% aqueous solution of sodium sesquicarbonate to inhibit flash rusting and oxidation. This is most important with iron, no other metal needs to be placed in an inhibitive solution at this point. All adhering concretions should be left intact. Note: Do not use inhibitive solution if wood or other organic matter is attached. Packing for transportation: wrap well with rags (pampers, whatever) completely saturated with sodium sesquicarbonate solution and place in polyethylene bag and tightly seal end. Add a bit more of the solution before sealing. Tightly seal other end and place in another bag. Cover doubly bagged object in bubble pack and bind with tape. Box and ship. *Always include tag with the object.

2. Copper/Alloys - Same procedure, but no inhibitive solution. Ship wet and well padded. Alloys: because of galvanic action between two metals (copper/tin; copper/zinc) metal is fragile and weak - care should be taken in wrapping these objects - never too tightly.

3. Lead - Can be brittle (anaerobic conditions) or structurally sound (oxidizing conditions) but either way, lead is a soft, easily crushable metal. Lead objects should be sent individually, well-wrapped in plastic containers. Never use a wooden box with lead - although individual, tightly sealed plastic containers can be placed in a wooden crate for shipment.

4. Silver - Thoroughly wet, padded, and protected for shipping.

5. Gold - Least problematic of all, most structurally sound, etc., but keep wet, pad etc. Security measures must be considered and prepared for in advance.

B. Ceramics - Very important to keep wet to avoid salt crystallization on the surface. Salt florescence can cause blistering, flaking of glaze, and physical damage to the paste in a relatively short period of time. Wrap well in wet rags and water for transportation.

C. Glass - The rate of decomposition of glass is affected by:

1. Composition of glass

2. pH of attacking solution

3. Temperature (rate doubles for every increase of $10^{o}C$)

4. Time

5. Pressure (increases rate of diffusion of ions) - Glass can delaminate (iridescent "onion skin" layers are easily brushed off very fragile. These layers can be used for dating in some instances. Do not mechanically clean or remove material adhering to surface as it can destroy data potential.) - Keep wet, pack very well with wet rags, double bag, etc. - Mark - VERY FRAGILE - on crate - Handle with extreme care.

D. Stone - Stone can give the appearance of structural stability, but sea water can be corrosive, and stone is also subject to attack by marine borers, causing structural as well as chemical insecurity. Stone should, therefore, be handled with care, properly supported - well wrapped (wet) and padded.

E. Composite objects and composite concretions - These should be sent actually submerged in sea water; use a large plastic container, but place object(s) in polyethylene bag perforated to allow free passage of water. Mark these: IMMEDIATE ATTENTION: COMPOSITE MATERIAL.

IV. Organic Materials - Lifting of any leather, rope, textile, book, or fragile wood should be done with a tray sliced through supporting sediment and placed in a polyethylene bag while under water, leaving ample water in bag. These objects can easily fall apart with the least disturbance. Ship to lab, tray and all. While photographing them - leave on tray and keep wet. Limit air exposure to 60 seconds between takes and thoroughly wet object in between.

Additional notes -

1. Take water samples of sea water in immediate proximity to find and send object to conservation laboratory.

2. Label water sample object tag number if things are found in the same area, one sample will suffice - then label bottle with all tag numbers (just write it on with waterproof markers).

3. Water-logged wood is very spongy, but can be cleaned (surface) only for photography with very soft brush on surface alone. If the object appears very weak - don't even do this - the foreign material may be the only thing holding it together.

4. For wet shipping, use sea water throughout.

5. When double bagging with wet rags, always include water in the poly tube to ensure total wetness.

6. You can send similar objects wrapped individually in one container, but make sure they are of the same size, weight, and material. Use bubble pack for filling in box for shipment.

7. On documentation form, describe condition visually - e.g., what patina looks like. You don't have to know exactly what it is. Include description of damage, disfigurement, and insecurity.

   Damage - physical breaks, dents, tears, etc.

   Disfigurement - surface accretions, dirt, etc.

   Insecurity - indicative of progressive

   Deterioration, extreme fragility, etc.

8. All these objects are fragile - easily damaged by rough handling and impacts in shipping. Try to have the staff make boxes with screw

lids. Mark top all the way around. Send as fast as possible to the conservation laboratory, at least in the same week as retrieval.

NATIONAL PARK SERVICE

MARINE ARCHEOLOGICAL INVENTORY SURVEY, DRAKES BAY
POINT REYES NATIONAL SEASHORE
OBJECT DOCUMENTATION RECORD

TAG NUMBER ____________________ DATE OF RECOVERY ____________________

SITE NUMBER ____________________ RECORDED BY ____________________

SITE NAME ____________________ DATE ____________________

OBJECT/ENCRUSTATION

Preliminary description:

Composition: ____________________
Size: (L) __________ (W) __________ (Th) __________ (Dia) __________
Color: ____________________
Condition: ____________________

Field drawing number ____________________
Photographs: B/W ____________________
Color ____________________

LOCUS

Horizontal position: ____________________
Bottom description: ____________________
Type of deposit: ____________________
Depth of deposit: ____________________
Locus map number: ____________________

ASSOCIATIONS

STORAGE/PACKING

Description ____________________

Packed by: ____________________

Disposition: ____________________

IX. MANAGEMENT RECOMMENDATIONS

Point Reyes National Seashore and Point Reyes-Farallon Islands Marine Santuary has a particularly rich resource base of historic shipwrecks. The research conducted in 1982 has resulted in a much better understanding of the underwater environment in the Seashore and Sanctuary and has resulted in the identification of areas of high and low cultural resource sensitivity. The specific management recommendations offered below are aimed at placing future research into a long-term management framework so that a logical followup to the Phase I work will have minimal impact on the area's personnel and funding resources.

1. It is important that the underwater remote sensing data obtained in 1982 are "ground truthed" by divers in the near future. This will complete the baseline survey of the most critical portions of the park's submerged lands. It would also provide a finished model for possible application in more than a dozen other areas of the National Park System.

2. The active high-energy coast within the National Seashore will be constantly changing and reforming as a result of wind-generated wave action. It is likely that vestiges of historic shipwrecks will be exposed periodically, which presents management with both an opportunity and a problem. On the one hand, it will permit us to update continuously our understanding of the historic resource base, and will offer clues to the location of offshore submerged sites, while on the other hand, these sites may also be subject to vandalism. It is recommended that the park staff pay special attention to wreck remains during regular patrols of the shoreline in both Seashore and Sanctuary. It is particularly important to do beach-line surveys after storms and during low tide. New members of the Seashore and Sanctuary staff should be taught what to look for by Western Regional cultural resource personnel and encouraged to remove small diagnostic items if, in their judgement, they would be particularly attractive to collectors. Appropriate cultural resource specialists in the Region should be contacted if artifacts are removed, and every effort should be made to pinpoint the location of the material and to photograph it in place. All structural elements should be documented photographically and measured each time they appear. Exposed elements can be tagged in some manner to ensure accurate identification, should they be re-exposed in the future. Where possible, distance and orientation of structural elements to other structural elements or to a stable known point, such as a bench mark, should be recorded. These data will provide information that will increase understanding of wreck formation and deterioration processes.

3. The waters of both the Marine Sanctuary and the National Seashore are extremely rich in submerged cultural and natural resources. The area off the headlands has an impressive and vibrant benthic community, which was often remarked upon by researchers working on the wrecks. An active dive

program seems critical for monitoring attrition to the shipwreck sites and for becoming more familiar with the underwater natural environment. It is recommended, therefore, that Point Reyes protection and interpretation personnel be encouraged to develop and maintain a strong diving program to ensure that submerged resources in the park are awarded their due attention. It would also be helpful if these activities were conducted in a highly visible manner. Submerged Cultural Resources Unit personnel have noted in many other park areas that the public is much more likely to award submerged resources the same respect they do those on land if the park management has visibly demonstrated its management control over those resources.

4. Both the Western Regional Archeologist and the management of the National Seashore and the Marine Sanctuary have demonstrated an exceptional sensitivity toward public interest, and a talent for harnessing the energy of outside agencies or groups in the private sector. It is recommended that this strategy of encouraging public involvement in efforts at meeting established management goals be continued. This could become a model approach that is worth exporting to other areas of the National Park System and that may have similiar concerns and similar opportunities for public assistance.

5. Historical research by Regional cultural resource specialists, and Seashore and Sanctuary personnel should continue on a periodic basis, and contact should be maintained with local amateurs, historians and sport divers. It may be worth contacting some local universities to encourage graduate-level history students to focus on the area's historic resources in their master's theses and doctoral dissertations.

6. Seashore and Sanctuary management should consider the development of a submerged cultural resource management plan, which identifies a strategy for monitoring the resource base, and which provides a phased plan that is in line with other committments and priorities for accumulating additional data over a 10 or 15-year period.

GLOSSARY

Aftercabin - Cabin near the stern.

Alluvial - Pertaining to unconsolidated terrestrial sediment composed of sorted or unsorted sand, gravel and clay that had been deposited by water.

Anticline - An upward fold that is convex with the oldest strata at the center.

Amidships - At or near the middle point of a vessel's length.

Anomaly - A local disturbance in the normal magnetic field of the earth. There can be many sources. Archeologists are interested in those of cultural origin. Normally in the marine environment, anomalies of archeological interest are caused by the presence of ferrous material, which has a magnetic field of its own and causes a positive or negative reading to the earth's normal ambient field.

Arquebus - (Harquebus) Originally a heavy matchlock gun, later a wheellock. It was usually smaller than a musket, which was the largest gun carried and used by a single man. Early muskets were fired from a rest; arquebuses could be hand-held.

Artifact - Object of material culture. Anything made or modified by humans.

Athwartship - Across the ship at right angles to the centerline.

Ballast - Any type of weight usually distributed along the centerline of a ship to prevent the vessel from becoming top-heavy and heaving over or losing way. Usually found low in the hull. Early ballast was stone, later iron became more common.

Barque - (Bark) Three-or-more-masted vessel square-rigged on the foremast and fore-and-aft-rigged on the after masts.

Batholith - A great irregular mass of coarse-grained igneous rock which has either intruded the country rock or been derived from it through metamorphism.

Bilge - Curved section between the bottom and side of the ship; recess in hull bottom.

Billet head - A small scroll used for a figurehead as an ornament on the bow of a ship.

Breech blocks - The hollow metal containers that were loaded with powder and shot and inserted into ancient gun tubes such as bombards. A single gun tube would have several breech blocks loaded and ready for firing.

Breeches buoy - A ring buoy or device for bringing shipwrecked persons ashore. A line is rigged from the ship to shore or to another vessel. Name derived from the canvas breeches in the ring used to secure a person.

Brig - Two-masted ship square-rigged on both masts.

Bulkhead - Vertical partition corresponding to a wall in a room extending either athwartships or fore and aft.

Bulwarks - The ship's side that extends above the top (weather) deck.

Carling - A piece of wood or angle iron or steel fitted in a fore-and-aft direction between deck beams.

Cesium magnetometer - Uses cesium gas in the sensor instead of rubidium. See rubidium magnetometer.

Conglomerate - A sedimentary rock which has a significant fraction of rounded pebbles and stone in its composition.

Contact - Generally referred to as a recording of interest on a side scan sonar or sub-bottom profile readout. When using a metal detector, it means a positive reading.

Deck beams - Athwartship member that supports a portion of the deck.

Dipolar - A magnetic reading that contains both positive and negative readings from the normal ambient magnetic field of the earth.

Dog holes - Narrow coves used for docking purposes on the California and Oregon coast.

Epicenters - The point on the earth's surface directly above the focus of an earthquake.

Estero - An estuary or inlet. In Point Reyes they are submerged stream channels.

Falls - The rope, which with the blocks (pulleys), constitutes a tackle.

Felucca - A lateen-rigged vessel of two or three masts.

Forecastle - The forward upper portion of the hull. Sometimes used for crew quarters.

Foreset bedding - An inclined bed deposited on the outer front of a delta.

Frame - Rib of a ship. Hull planks are attached to frames.

Gamma - The agreed unit of measurement for magnetic intensity. The earth's magnetic field varies from 25,000 to 70,000 gammas depending on geographic location, local conditions and solar influences. A magnetometer should be able to resolve 1 gamma in the total field.

Ground truth - The physical on-the-ground or in-the-water examination of areas of interest indicated by remote sensing data.

Hatch - An opening in a deck.

Hatch coaming - Vertical boundary of a hatch or skylight.

Hawser - Large rope or cable used for towing, mooring or anchoring.

Hide droghing - Name given to the act of carrying processed cattle hides to load aboard a ship.

Ideal geometry - The situation where three points produce an equilateral triangle. In electronic positioning, it is usually a range of more than 30° to less than 150° with 90° ideal (this angle is the intersection angle drawn from two points).

Igneous - Of volcanic origin.

Knees - A support to rigidly connect two portions of a ship's structure, e.g., a beam to a frame.

Lane spacing - The distance between parallel courses of a survey vessel. Distances are varied because of differences between remote sensing instrumentation and desired target characteristics.

League - (Marine League) Generally four Roman miles of 5,000 feet to the mile or 17 1/2 leagues to a degree of latitutde (three present-day nautical miles per league). Cermeno's league measures between 2.2 and 2.4 nautical miles (Aker 1965:73). Land league is shorter than marine league, generally 1.22-1.36 statute miles (Aker 1965:73-4).

Junk - An Oriental vessel, Chinese or Japanese, usually of lateen rig.

Lodging knees - Support brackets placed horizontally fore and aft. Can be found inside hatches attached to deck beams.

Longitudinal framing - Principal support members which run fore and aft.

Magnetic deflection - Reading which is less or greater than the earth's normal ambient magnetic field; an anomaly.

Magnetometer - A sophisticated electronic instrument that accurately determines the strength of the earth's (or any other) magnetic field.

Material culture - Full range of physical objects that are produced and used by a social group.

Musket shot - A distance of approximately 1,450 feet (Aker 1965:74).

Optical positioning - Survey methods based on use of optical or electro-optical instruments such as a transit, theodolite or theodolite - electronic distance measuring device combination.

Orogenic - Relating to the tectonic process in which large areas are folded and subjected to igneous conditions. The cycle ends with uplift and mountain formatons.

Partisans (Partizans) - Broad bladed pole arm, usually with short, curved blade attached to base. Used throughout the 16th and 17th centuries. Still in ceremonial use.

Phase I Survey - A reconnaissance survey. Determines if cultural materials exist in an area.

Phase II Survey - Determination and evaluation of nature and significance of cultural materials located in a Phase I Survey. Usually involves test excavation.

Pikes - Spear of the heavy infantry. Comparatively small head, usually leaf or diamond-shaped and mounted on a very long shaft. Originally used as a defense against calvary.

Port side - Standing amidships facing toward the bow, the left side of a vessel.

Proton precession magnetometer - An electronic instrument that uses variations in the minute electronic field produced by spinning protons to measure magnetic fields.

Raking masts - Masts which are angled from the perpendicular, usually aft.

Regional approach - Viewing an archeological site in the context of a geographical area that has certain commonalities, e.g.,political boundaries.

Remote sensing - Collection of pertinent data through the use of electronic or photographic equipment that normally detect phenomena beyond the capability of human senses.

Rift zone - A geological fault, divergence area or other area of tension. Regarding Point Reyes, the San Andreas Fault.

Rubidium magnetometer - A device for measuring magnetic intensity that uses the excitation of electrons in a rubidium (Rb^{85}) gas. This magnetometer senses continually and can have a resolution of .1 gamma.

Sandwich Islands - Old name for the Hawaiian Islands.

Scantlings - Dimensions of various structural members such as frames, beams, etc. Minimum dimensions changed through time and were often set by various agencies, such as Lloyd's of London for insurance purposes.

Schooner - Multiple masted vessel with sails rigged fore-and-aft (sails parallel to centerline).

Scupper - A deck drain used to divert deck water overboard.

Sheathing - Thin sheets of metal, usually copper, applied to the hull bottom of ships below the waterline to prevent marine borers from weakening the hull planks.

Ship - Strictly, a vessel with three or more masts, square-rigged. The term is loosely applied to all large vessels.

Side scan sonar - An electronic instrument which horizontally sends out micro second pulses of sound in fraction-of-a-second intervals. Returning sound is reflected off the sea bottom and objects above it, measured and portrayed on a graph to give a topographic rendition of the sea bed.

Signature - In shipwreck application, it is an organization of data gained from remote sensing that can be recognized to represent an archeological site.

Slant range - The horizontal distance coverage of a side scan sonar instrument. This is usually adjustable , e.g., from 50 to 600 meters or more on a side. Image resolution is reduced when the higher ranges are used.

Spit - A long ridge of sand deposited by longshore current and drift where the coast makes an inward turn. It is attached to land at the upstream end.

Square-rigged - Mast, carrying sails that are square (rigged at right angles to the centerline of the vessel). Square sails are rigged from yards and are rectangular in shape.

Starboard side - Facing toward the bow from amidships the right side of the vessel.

Steam schooner - West coast vessel, with both sail and steam capabilities.

Sternson - A member added inboard of the sternpost for added support.

Stratified - (Surveys) A survey area is divided into sub areas, (sub populations) which share some elements of commonality and each are separately surveyed (sampled).

Strike - Slip fault: A fault whose relative displacement is purely horizontal.

Sub-bottom profiler - An instrument that sends out pulses of sound vertically which penetrate the sea bed. Different sediment layers have different sound reflection characteristics. The returning sound is graphed. An indication of the sediment layers beneath the sea floor is portrayed by the instrument.

Tallow - Animal fat.

Tectonic - Relating to the movements and deformation of the earth's crust on a large scale.

Terminus ante quem - Irrefutable date before which everything was produced and in use, e.g., a vessel that was sunk in 1700 carries only material made and in use before that date.

Test excavation - Carried out to answer specific questions, e.g., determine the cause of a magnetic anomaly or determine extent of site dispersal.

Ton - A unit representative of a ship's capacity or size. It is important to note that this measurement has changed over time. The Castilian ton or tonelada was equal in weight to 20 quintals or hundredweight. In Spanish vessels of the 16th and 17th century this was estimated to be a space of something over 56 cubic feet (Haring 1918:284). In modern ships it represents 100 cubic feet or 2.83 cubic meters. Displacement tonnage is figured at 35 cubic feet per ton of water displaced. Naval ships are usually rated in displacement. In modern merchant ships the capacity is registered as both gross and net tonnage. Gross tonnage is all permanently enclosed space above and below deck available for

cargo, stores and accommodations, but with certain specified exceptions. Net registered tonnage is actually "carrying space" for it is calculated from gross tonnage by deducting certain allowable non-carrying spaces like crew, machinery and tanks. One must be careful in designating and comparing tonnages of ships of different types and periods so as to not be misled regarding size of vessels discussed.

Toprail - Rail on the uppermost deck of a vessel.

Transducer - The part of a submerged sonic instrument that emits and receives a sound impulse in the water.

Transects - Lanes or paths of a survey vessel. Usually evenly spaced and parallel through the survey area.

Triple-expansion engine - An engine which uses three cylinders to benefit from the expansion of steam three times. The steam is introduced in the smallest or high-pressure cylinder, then from there into the middle cylinder and finally into the largest.

'Tween decks - Any space between two decks on a ship.

Waterway - The last outboard plank of a wooden deck, hollowed so as to carry off the water through the scuppers.

REFERENCES CITED

Aker, Raymond
1965 The Cermeno Expedition at Drakes Bay, 1595. Report of the Drake Navigators Guild. Drakes Navigator Guild, Palo Alto.

Arnold, J. Barto, III
1975 A Marine Archaeological Application of Automated Data Acquisition and Processing. Newsletter of Computer Archeology 11(4):5-12.

1977 Site Test Excavations: The Sequel to Magnetometer Survey. International Journal of Nautical Archaeology and Underwater Exploration 6(1):21-36.

Arnold, J. Barto, III, and C. J. Clausen
1975 A Magnetometer Survey with Electronic Positioning Control and Calculator Plotter System. International Journal of Nautical Archaeology and Underwater Exploration 4(2):353-6.

Bancroft, Hubert Howe
1964 California Pioneer Register and Index, 1542-1848. Regional Publishing Company, Baltimore.

Barfield, Thomas
1983 Personal communication. Local historian, Bolinas.

Bari, Valeska
1931 The Course of Empire. Coward-McCann, New York.

Becker, Robert J.
n.d. Fishing Industry in Drakes Bay, Supplemental Historical Report, Point Reyes National Seashore Proposal. Ms. on file, Point Reyes National Seashore.

Breiner, Sheldon
1965 The Rubidium Magnetometer in Archeological Exploration. Science 150:185-193.

1973 Application Manual for Portable Magnetometers. Geometrics, Sunnyvale.

Breiner, Sheldon and Robert MacNaughton
1965 The Application of Magnetometers to Underwater Archaeology. Paper presented at the 2nd Conference on Underwater Archaeology, Toronto, Canada.

Brown, Alan K.
1966 Sawpits in the Spanish Redwoods, 1787-1849. San Mateo County Historical Association, San Mateo.

Burgess, Sherwood D.
1951 The Forgotten Redwoods of the East Bay. California Historical Society Quarterly 30(1):1-14.

1962 Lumbering in Hispanic California. California Historical Society Quarterly 41(3):237-248.

Chappell, Gordon
1976 F.E. Booth Company Pier, Consolidated Fish Company Pier, F. Alioto Fish Company Pier, National Register of Historic Places Inventory. Nomination Form, National Park Service, San Francisco. Ms. on file, Point Reyes National Seashore.

Cherry, John
1965 Sand Movement Along a Portion of the Northern California Coast. U.S. Army Coastal Engineering Research Center, Technical Memorandum No. 14.

Christensen, M.N.
1965 Late Cenozoic Deformation in the Central Coast Ranges of California. Geological Society of American Bulletin 76:1105-1124.

Clarke, Dwight L.
1969 William Tecumseh Sherman: Gold Rush Banker. California Historical Society, San Francisco.

Clarke, J.C., E.E. Green, H.G. Greene and D.C. Ross
In press, Geology of Point Reyes Peninsula and Implications for San Gregorio Fault History. Society of Economic Paleontologists Special Publication.

Clausen, Carl. J.
1966 The Proton Magnetometer: Its Use in Plotting the Distribution of Ferrous Components of a Shipwreck Site as an Aid to Archeological Interpretation. Florida Anthropologist 19:77-84.

Clausen, Carl J., and J. Barto Arnold, III
1976 The Magnetometer and Underwater Archaeology: Magnetic Delineation of Individual Shipwreck sites, a New Control Technique. International Journal of Nautical Archaeology and Underwater Exploration 5(2):159-169.

Cockrell, W.A.
1980 Drowned sites in North America. In Archeology Underwater: An Atlas of the World's Submerged Sites, edited by Keith Muckelroy. McGraw Hill, New York.

Couglin, Magdalen C.S.J.
1967 Boston Smugglers on the Coast (1796-1821): An Insight into the American Acquisition of California. California Historical Society Quarterly 46(2):99-120.

Chronicle. San Franciso.
September 8, 1883

Daily Alta California. San Francisco.
February 21, 1871
February 24, 1871
April 2, 1879
April 12, 1879

Daily Evening Bulletin. San Francisco.
April 27, 1867

Dana, Richard Henry
1936 Two Years Before the Mast. The Modern Library, New York.

Davis, William Heath
1967 Seventy-five Years in California. John Howell Books, San Francisco.

Delgado, James
1979 No Longer a Buoyant Ship: Unearthing the Store Ship Niantic. California History 58(4).

1981 What Becomes of the Old Ships? Dismantling the Gold Rush Ships of San Francisco. Pacific Historian 25(4).

1981 Gold Rush Jail: The Prison Ship Euphemia. California History (2):134-141.

1982 A Ship of '49: Fact and Fiction. Book Club Quarterly 47(2).

Doran, Edwin, Jr., and Michael F. Doran
1978 A Reconstruction of the Padre Island Ship. The Nautical Archaeology of Padre Island by J. Barto Arnold III and Robert S. Weddle, Appendix E, pp. 375-384. Academic Press, New York.

Dowling, Rev. Edward J. S.J.
The "Lakers" of World War I. University of Detroit Press, Detroit.

Drake, Sir Francis
1628 The World Encompassed. London. Readex Microprint.

Dumas, F.
1962 Deep Water Archaeology. Routledge and Kegan Paul, London.

1972 Ancient Wrecks. In Underwater Archaeology: A Nascent Discipline, pp. 27-34. UNESCO, Paris.

Edwards, Malcolm
1977 "The War of Complexional Distinction": Blacks in Gold Rush California and British Columbia. California Historical Quarterly 56(1):35-45.

Evans, Peter A.
1969 Shipwrecks and Strandings on the Coast of Point Reyes National Seashore 1840-1940. A research paper presented to the faculty of the Department of Librarianship. San Jose State College.

1977 Shipwreck! The Munleon, November 7, 1931. Point Reyes Historian 2(1):163-165.

Examiner. San Francisco.
September 10, 1883
November 8, 1913

Farris, N. M., and A. G. Miller
1977 Maritime Culture Contacts of Maya: Underwater Surveys and Test Excavations in Quintana Roo, Mexico. International Journal of Nautical Archaeology and Underwater Exploration 6(2):141-151.

Fink, Colin G. and E. P. Polushkin
1942 Report on the Examination of Ten Iron Spikes Recently Found at Drake's Bay, California. Archaeological Evidence of Sebastian Rodriguez Cermeno's California Visit in 1595 by Robert F. Heizer, pp. 24-32. California Historical Quarterly 20(4).

Galloway, Alan J.
1977 Geology of the Point Reyes Peninsula, Marin County, California. California Division of Mines and Geology, Bulletin 202:72.

Goodman, John B.
n.d. Gold Rush Encyclopedia. Unpublished manuscript. Hollywood. Ms. on file Golden Gate National Recreation Area, San Francisco.

Green, J. N.
1970 A New Sea-going Magnetometer Detector Head. Archaeometry 12:167-72.

Hakluyt, Richard
1589 The Principall Navigations Voiages and Discoveries of the English Nation. London.

Hall, E. T.
1966 The Use of Proton Magnetometer in Underwater Archeology. Archaeometry 9:32-44.

Hamilton, Fletcher, editor
1971 Report XVII of the State Mineralogist: Mining in California During 1920. California State Printing Office, Sacramento.

Hammond, George P., Editor
1951-62 The Larkin Papers. University of California Press, Berkeley.

Hanna, Warren L.
1979 Lost Harbor, the Controversy over Drake's California Anchorage. University of California Press, Berkeley and Los Angeles.

Haring, Clarence H.
1918 Trade and Navigation Between Spain and the Indies in the Time of the Hapsburgs. Peter Smith, Gloucester.

Heizer, Robert L.
1942 Archaeological Evidence of Sebastian Rodriguez Cermeno's California Visit in 1595. California Historical Society Quarterly 20 (4).

Hine, Alred
1968 Magnetic Compasses and Magnetometers. University of Toronto Press, Toronto.

Hogg, O. F. G.
1970 Artillery: Its Origin, Heyday and Decline. Archon Books, London.

Hoskins, E.G. and J.R. Griffith
1971 Hydrocarbon Potential of Northern and Central California Offshore. American Association of Petroleum Geologists Memoir 15:212-228.

Huston, John
1965 Council of Underwater Archaeology: Drakes Bay Expedition. San Francisco.

1965 Letter to Paul Schumacher, Regional Archeologist National Park Service, San Francisco. December 1, 1965. On file Western Regional Office, San Francisco.

Kelly, Isabel
1978 Coast Miwok. Handbook of North AmericanIndians, edited by Robert F. Heizer. Vol. 8 pp. 414-425. Smithsonian Institution, Washington, D.C.

Kistler, R.W. and Z.E. Peterman
1973 Variations in Sr, Rb, K, Na and Initial Sr87/Sr86 in Mesozoic Granitic Rocks and Intruded Wall Rocks in Central California. Geological Society of America Bulletin 84:3489-3512

Klebingat, Fred
1983 Memories of the Audifred Building and the Old City Front. Privately Printed, San Francisco.

Kortum, Karl
1983 Chief Curator, National Maritime Museum, San Francisco. Personal communication.

Kortum, Karl and Roger Olmsted
1971 It is a Dangerous Looking Place: Sailing Days on the Redwood Coast. California Historical Quarterly 50(1).

Kozak, Garry
1980 Side Scanning Sonar: A Tool for the Diving Industy. Paper presented at International Diving Symposium, February 4-6, New Orleans; Klein Associates, Inc., Technical Bulletin No. 1002. Klein Associates, Salem.

Langan, Lee
1965 A Marine Rubidium Magnetometer - Initial Tests. Geophysics Technical Memorandum No. 24. Varian Associates, Palo Alto, California.

Lapp, Rudolph
1977 Blacks and the California Gold Rush. Yale University Press, New Haven.

Lenihan, Daniel J.
1974 Preliminary Archeological Survey of the Offshore Lands of Gulf Islands National Seashore. Underwater Archeology in the National Park Service, edited by Daniel J. Lenihan. Southwest Region, National Park Service, Santa Fe.

Link, M. C.
1959 Sea Diver. New York.

London, Jack
1964 The Sea Wolf. Signet Books, New York.

Lotchin, Roger
1974 San Francisco 1846-1856; from Hamlet to City. Oxford University Press, Oxford.

Ludwig, Ella A.
1928 History of the Harbor District of Los Angeles. Historic Record Company, Los Angeles.

Mason, Jack
1970 Point Reyes, the Solemn Land. North Shore Books, Inverness.

1976-82 Point Reyes Historian. Volumes I-VI. North Shore Books, Inverness.

McCulloch, D.S., H.G. Greene, K.S. Heston and D.M. Rubin
1980 A Summary Report of the Geology and Geologic Hazards in Proposed Lease Sale 53, Central California Outer Continental Shelf. U.S. Geological Survey Open-File Report 80-1095:76.

McKee, Alexander
1973 The Search for King Henry VIII's Mary Rose. Marine Archaeology, Colston papers No. 23, edited by D. J. Blackman, pp. 185-202. Butterworth, London.

McNairn, Jack and Jerry MacMullen
1945 Ships of the Redwood Coast. Stanford University Press,Standford.

Meighan, C.W.
1950 Excavations in Sixteenth Century Shellmounds at Drakes Bay, Marin County, California. University of California Archeological Survey Records No. 9, pp. 27-32.

Meighan, C. W. and R. F. Heizer
1952 Archaeological Exploration of Sixteenth Century Indian Mounds at Drakes Bay, California. California Historical Society Quarterly 31 (2):98-108.

Mendocino Beacon. Mendocino
June 24, 1882
July 29, 1882

Merrian, C. Hart
1977 Ethnogeographic and Ethnosynonymic Data from Central California Tribes. Archaeological Research Facility, University of California, Berkeley.

Michel, Helen V. and Frank Asaro
1977 Chemical Study of the Plate of Brass. Lawrence Berkeley Laboratory, University of California, LBL-6338 reprint. Prepared for the US Energy Research and Development Administration, Contract W-7405-ENG-48, Berkeley.

Minard, C.R., Jr.
1964 The Erosional and Depositional History of the Coast of Northern California. University of California, Berkeley, Hydraulic Engineering Laboratory, Technical Report Series HEL-2-10. University of California, Berkeley.

Moratto, Michael J.
1974 An Assessment of the Cultural Resources within Point Reyes National Seashore. Contract PX 810030185. Submitted to National Park Service. Copies available from Point Reyes National Park and Western Archeological Conservation Center, Tucson.

Morison, Samuel Eliot
1974 The European Discovery of America: The Southern Voyages 1492-1616. Oxford University Press, New York.

Morrell, Robert W.
1931 Oil Tankers. Simmons-Boardman Publishing Company, New York.

Muckelroy, Keith
1977 Historic Wreck Sites in Britain and Their Environments. International Journal of Nautical Archaeology and Underwater Exploration 6(1):47-57.

1978 Maritime Archaeology. Cambridge University Press, London.

Munro-Fraser, J. P.
1880 History of Marin County, California. Alley, Bowen, and Company, San Francisco.

Murphy, Larry
1980 Survey Methodology: Specific Site Survey of Biscayne National Monument, 1980. Ms. on file National Park Service, Southwest Cultural Resources Center, Santa Fe and Southeastern Archeological Center, Tallahassee.

Murphy, Larry, and Allen Saltus
1981 Phase II Identification and Evaluation of Submerged Cultural Resources in the Tombigbee River Multi-Resource District, Alabama and Mississippi. Report of Investigations No. 16. University of Alabama, Tuscaloosa.

Nunis, Doyce B., Jr., editor
1964 The California Diary of Faxon Dean Atherton, 1836-1839. California Historical Society, San Francisco.

Nuttall, Zelia
1914 New Light on Drake. A Collection of Documents Relating to His Voyage of Circumnavigation 1577-80. The Hakluyt Society. Second series No. XXXIV.

Ogden, Adele
1941 The California Sea Otter Trade: 1784-1848. University of California Press, Berkeley and Los Angeles.

Page, B.M.
1966 Geology of the Coast Ranges of Calfornia. In E.H. Bailey, ed. 1966, Geology of Northern Calfornia. California Division of Mines and Geology Bulletin 190:255-276.

Page, B.M.
1970 Sur-Nacimiento Fault Zone of California: Continental Margin Tectonics. Geological Society of America Bulletin 81:667-690.

Paty, John
1859 Reminiscence. San Francisco.

Paasch, Captain H.
1890 Illustrated Marine Encyclopedia. Argos Books, Watford, England.

Peterson, Mendel
1972a Wreck Sites in the Americas. Underwater Archaeology: A Nascent Discipline, pp. 85-94. UNESCO, Paris.

1972b Traders and Privateers across the Atlantic: 1492-1733. A History of Seafaring Based on Underwater Archaeology, edited by George F. Bass, pp. 253-280. Walker and Company, New York.

1974 Explorations of a 16th Century Bahamian Wreck. National Geographic Research Reports, 1967 Projects, pp. 231-242. National Geographic Society, Washington, D.C.

1975 The Funnel of Gold. Little, Brown and Company, Toronto.

Pomeroy, Earl
1965 The Pacific Slope: a History of California, Oregon, Washington, Idaho, Utah, and Nevada. University of Washington Press, Seattle.

Rasmussen, Louis J., editor
1966 San Francisco Ship Passenger Lists . Volume II. San Francisco Historic Records, Colma.

1970 San Francisco Ship Passenger Lists . Volume III. San Francisco Historic Records, Colma.

Rolle, Andrew F.
1956 An American in California: The Biography of William Heath Davis, 1822-1909. Henry E. Huntington Library, San Marino.

Rosencrantz, Donald M., M. Klein, and Harold E. Edgerton
1972 The Uses of Sonar. Underwater Archaeology: A Nascent Discipline, pp. 257-270. UNESCO, Paris.

Roske, Ralph J.
1963 The World Impact of the Gold Rush

Sale, Roger
1976 Seattle: Past to Present. University of Washington Press, Seattle.

San Francisco Maritime Museum
1960 The Steam Schooner Wapama: A Report to the State of California Division of Beaches and Parks. Ms. on file National Maritime Museum, San Francisco.

Scammon, Charles M.
1874 The Marine Mammals of the Northwestern Coast of North America Described and Illustrated, Together with an Account of the American Whale Fishery. G. P. Putnam's Sons, New York.

Schurz, William L.
1939 The Manila Galleon. E. P. Dalton, New York.

Shackelton, N.J. and N.D. Opdyke
1973 Osygen Isotope and Paleomagnetic Stratigraphy of Equatorial Pacific Core V23-238: Oxygen Isotope Temperatures and Ice Volumes on a 10^5 Year and 10^6 Year Scale. Quaternary Research 3:39-55.

Shangraw, Clarence and Edward P. Von Der Porten
1981 The Drake and Cermeno Expeditions' Chinese Porcelains at Drakes Bay, California: 1579 and 1595. Santa Rosa Junior College, Santa Rosa, and Drake Navigators Guild, Palo Alto.

Thomes, William H.
1884 On Land and Sea, or California in the Years 1843, 44, and 45. De Wolfe, Fiske, Boston.

Toogood, Anna C.
1980 Historic Resource Study: A Civil History of Golden Gate National Recreation Area and Point Reyes National Seashore, California. National Park Service, Denver.

Treganza, A. E.
1957 The Examination of Indian Shellmounds within San Francisco Bay with Reference to the Possible Landfall of Sir Francis Drake. Vacaville.

Treganza, A. E. and T. F. King
1968 Archaeological Studies in Point Reyes National Seashore, 1959-1968. National Park Service, San Francisco and Tucson.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management.
1980 Final Environmental Impact Statement on the Proposed Point Reyes-Farallon Islands Marine Sanctuary. Volume I. Government Printing Office, Washington, D.C.

U.S. Life-Saving Service
1883 Annual Report.

1891 Annual Report.

1905 Annual Report.

1910 Annual Report.

1912 Annual Report.

1913 Annual Report.

1914 Annual Report.

Von Der Porten, Edward P.
1973 Drake and Cermeno in California: Sixteenth Century Chinese Ceramics. Drake Navigators Guild, Point Reyes (1972 Historical Archaeology 6.)

Wagner, Henry R.
1924 The Voyage to California of Sebastian Rodriguez Cermeno in 1595. Notes and translation by Henry R. Wagner. California Historical Quarterly 3(1):3-24.

1926 Sir Francis Drake's Voyage Around the World. Its Aims and Achievements. John Howell, San Francisco.

Waters, Davis W.
1958 The Art of Navigation in England in Elizabethan and Early Stuart Times. Hollis and Carter, London.

Wilterding, John H.
1981 Duluth-Superior Shipbuilding, 1917-18: The Pre-War Frederickstad Ships. The Nor' Easter: Journal of the Lake Superior Marine Museum Association, 6(2):1-5.

1981 Duluth-Superior Shipbuilding, 1918-20: The American "Lakers". The Nor' Easter: Journal of the Lake Superior Marine Museum Association 6(6):1-5, 8.

APPENDIX I

Horizontal Control Points for Drakes Bay, Point Reyes National Seashore Developed During Phase I Shipwreck Survey, 1982

Point 1
Name: East Point Reyes (USGS Monument)
Latitude: 37°59'25.740"
Longitude: 122°57'52.906"
Lambert: (California State Grid Zone 3) X/E=1289780.84
Y/N=552044.38
UTM (Zone 10) X=503100.065
Y=4204554.162

Central Meridian W 123
Scale Factor: 0.99960012
Convergence Angle: 01°18.230
Note: All positions are NAD-27

Point 2
Name: Satellite Point 1 (Chimney Rock)
Latitude: 37°59'35.464"
Longitude: 122°58'01.027"
UTM X=502901.872
Y=4204853.776
Scale Factor: 0.99960010
Convergence Angle: 01°13.226

Point 3
Name: 216, Commercial Survey Point 4
Latitude: 38°01'26.30"
Longitude: 122°58'02.16"
Lambert: X=1289361.44
Y=564253.68
UTM X=502873.035
Y=4208269.566
Scale Factor: 0.99994153.4
Convergence Angle: 1°29'45"

Point 4
Name: Commercial Survey Point 3 (intermediate point)
Latitude: 38°01'45.88"
Longitude: 122°57'16.94"
Lambert: X/E=1293030.45
Y/N=566138.87
UTM X=503975.14
Y=4208873.54
Scale Factor: 0.999941534
Convergence Angle: 1°29'45"

Point 5
Name: Commercial Survey Point 2 (Pacific - not USGS monument "Pacific")
Latitude: 38°01'54.661"
Longitude: 122°56'28.973"
Lambert: X=1296890.48
Y=566926.17
UTM X=505144.533
Y=4209144.723
Scale Factor: 0.999941536
Convergence Angle: 1° 29'45"

Point 6
Name: Lagoon (USGS Monument 1930) (Drakes Head)
Latitude: 38°02'01.464"
Longitude: 122°54'53.228"
Lambert: X=1304566.08
Y=567415.33
UTM X=507478.36
Y=4209356.22

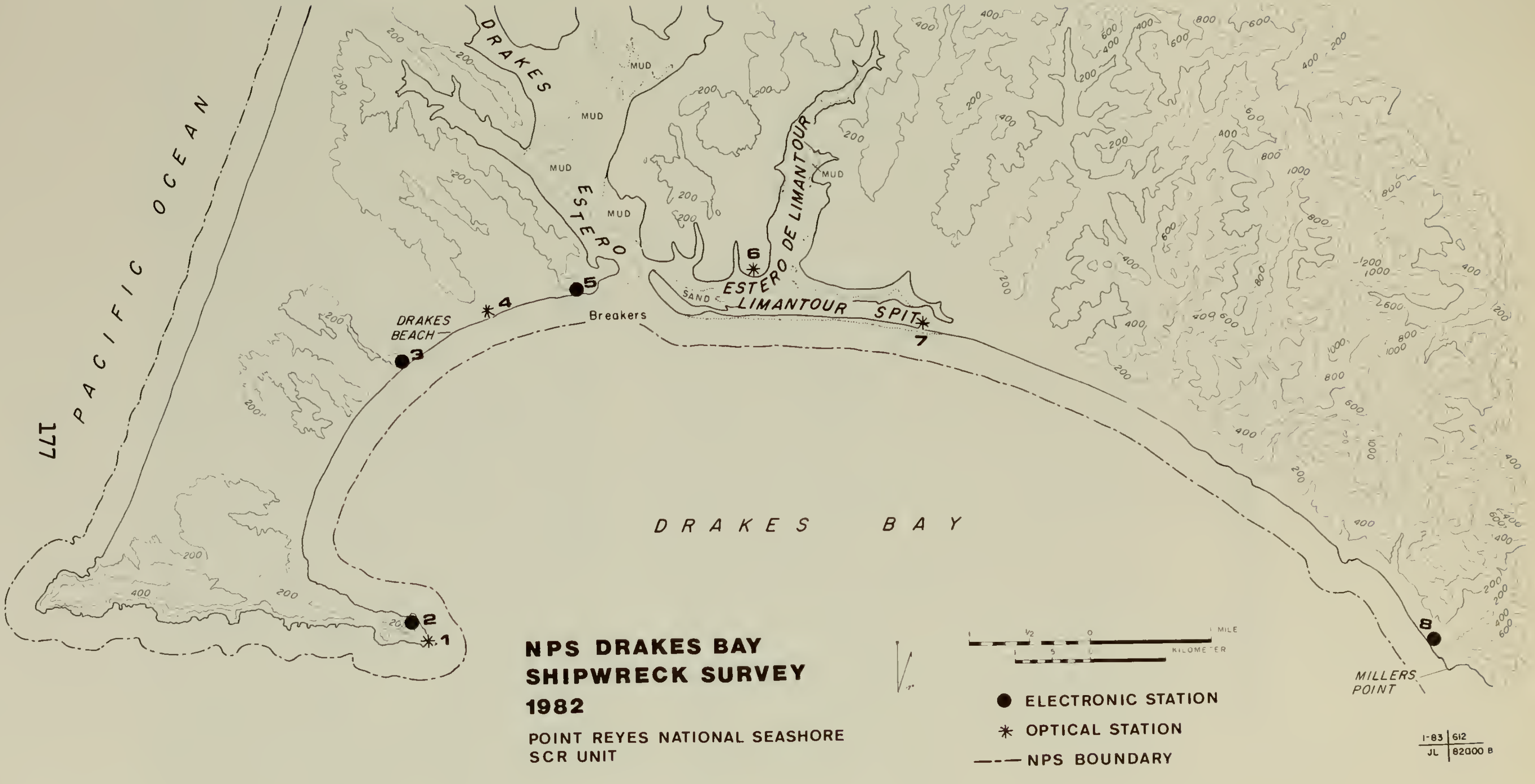
Point 7
Name: Satellite Point 3 (Limantour Spit)
Latitude: 38°01'37.630"
Longitude: 122°53'.988"
UTM X=509703.443
Y=4208624.113
Scale Factor: 0.99960116
Convergence Angle: 04°05.189

Point 8
Name: Satellite Point 2 (Arch Rock)
Latitude: 37°59'21.680"
Longitude: 122°48'49.369"
UTM X=516358.227
Y=4204444.810
Scale Factor: 0.99960330
Convergence Angle: 06°52.784

UTM Grid Azimuths between Horizontal Control Stations
At Point Reyes National Seashore

Stations	Azimuths
1-2	326°30'56"
1-3	356°30'11"
1-4	11°27'9.74"
1-5	24°0'23.19"
1-6	42°21'25.6"
1-7	58°21'9.41"
1-8	90°28'21.2"
2-1	146°30'56"
2-3	359°30'58"
2-4	14°56'56.8"
2-5	27°35'37.6"
2-6	45°28'2.17"
2-7	60°59'56"
2-8	91°44'26.8"
3-1	176°30'11"
3-2	179°30'58"
3-4	61°16'35.1"
3-5	68°55'46"
3-6	76°43'24.7"
3-7	87°1'42.97"
3-8	105°50'5"
4-1	191°27'9.74"
4-2	194°56'56"
4-3	241°16'35"
4-5	76°56'37.8"
4-6	82°9'18.28"
4-7	92°29'35.7"
4-8	109°40'45"
5-1	204°0'23.1"
5-2	207°35'37"
5-3	248°55'46"
5-4	256°56'37"

5-6	$84^{\circ}49'18.7''$
5-7	$96^{\circ}30'53.1''$
5-8	$112^{\circ}44'22''$
6-1	$222^{\circ}21'25''$
6-2	$225^{\circ}28'2.1''$
6-3	$256^{\circ}43'24''$
6-4	$262^{\circ}9'18.2''$
6-5	$264^{\circ}49'18''$
6-7	$108^{\circ}12'45''$
6-8	$118^{\circ}56'48''$
7-1	$238^{\circ}21'9.4''$
7-2	$240^{\circ}59'56''$
7-3	$267^{\circ}1'42.9''$
7-4	$272^{\circ}29'35''$
7-5	$276^{\circ}30'53''$
7-6	$288^{\circ}12'45''$
7-8	$122^{\circ}7'45.8''$
8-1	$270^{\circ}28'21''$
8-2	$271^{\circ}44'26''$
8-3	$285^{\circ}50'5''$
8-4	$289^{\circ}40'45''$
8-5	$292^{\circ}44'22''$
8-6	$298^{\circ}56'48''$
8-7	$302^{\circ}7'45.8''$



Appendix I

Figure 1. Horizontal Control Points Established or Used During 1982 Survey

APPENDIX II

Erosion-Exposed Shipwreck Remains, Winter 1982

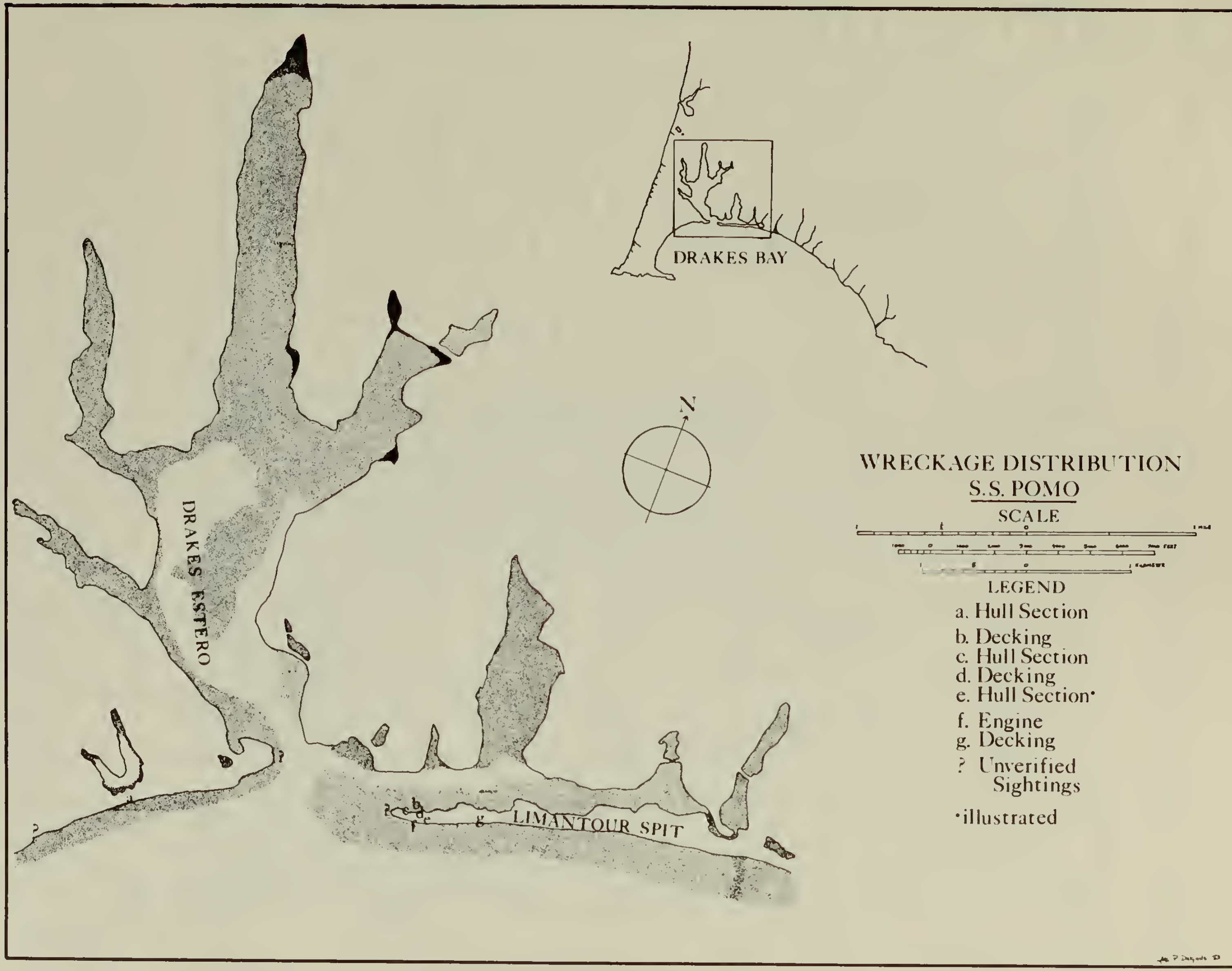
James P. Delgado

Severe and prolonged winter storms in late 1982 and early 1983 resulted in extreme beach erosion on the Northern California coast. In San Francisco, sand levels at Ocean Beach on the city's western shore dropped more than 3 meters exposing the remains of the 1882 two-masted schooner Neptune, which had wrecked on the beach on August 10, 1900, and the remains of the 1856 three-masted ship King Phillip, which wrecked on January 25, 1878 (Delgado 1983). South of San Francisco on the San Mateo County coast, the wreckage of two wooden steamers was exposed at Ano Nuevo State Reserve; the two vessels were identified as the 1887 steam schooner Point Arena, wrecked on August 9, 1913, and the steamer City of Columbia lost on Point Ano Nuevo on July 14, 1896. Additionally, blocks, sheaves, deadeyes and chainplates from the 1859 barque J.W. Seaver were washed ashore at Ano Nuevo near the spot where the ship had foundered on April 10, 1887. North of San Francisco, in Humboldt County, the remains of one--possibly two--unidentified vessels were exposed by beach erosion at Little River (Krei 1983). In Marin County, the sternson and associated timbers from a mid-19th century vessel were washed ashore at Rodeo Lagoon within the Golden Gate National Recreation Area, and eight known pieces of wreckage from the 1903 steam schooner Pomo, whose wreck site had been pinpointed in late 1982 during the Point Reyes submerged cultural resource survey, were exposed on a wide stretch of coast running from Drakes Beach to Limantour Spit.

S.S. Pomo, as recounted elsewhere in this report, was a wooden-hulled steam schooner 130.5 feet long, with a 32.6 foot breadth, a 10.7 depth of hold, and a registered gross tonnage of 368 tons (Merchant Vessels 1912). Pomo, after being battered and abandoned in stormy seas, was under tow to San Francisco when the hawsers parted and the ship was cast ashore and capsized near the entrance to Drakes Estero in Drakes Bay on January 2, 1914. Salvage activity commenced almost immediately, with the capsized ship being righted and the hull cargo of lumber and small machinery probably removed. However, a complete salvage of Pomo does not seem to have been accomplished, perhaps due in part to the fact that the ship appears to have disintegrated rapidly. A progression of photographs made over a short period of time immediately after Pomo's grounding indicate Pomo was rather quickly battered apart. This rapid disintegration is probably the reason for the remarkable survival and preservation of eight large pieces of the hull exposed in the winter of 1982-83. As a result of the rapid breakup, the ship did not deteriorate to a point where the separate timbers parted and the hull disintegrated into individual, isolated frames and planks. Rather, large sections of the vessel retained some degree of structural integrity and buoyancy and floated ashore relatively intact to be deposited on a broad stretch of beach.

Available evidence indicates a widespread distribution of Pomo wreckage. Sections of the hull were observed in 1983 along Limantour Spit, running from the current estero entrance to a point approximately one mile east along the coast; additional wreckage was noted on the western shore of the estero at Haypress Pond (Figure 1). A report (Aker 1983) of Pomo wreckage, which is now not visible at Drakes Beach and presumed destroyed in the early 1960s, would indicate a widespread wreckage distribution with portions of Pomo deposited on a 2-3/4 mile stretch of Drakes Bay coastline. The no-longer-visible wreckage observed in past years was noted by Naval Architect Raymond Aker (it would appear that at least one of the pieces of wreckage he saw was again exposed in 1983 and is a section of hull laying on the beach west of the estero entrance below the Haypress Pond). The wreckage at Drakes Beach, according to Aker, was a "large" section of the ship's hull, with associated knees still attached to the frames. Bonfires built inside the wreckage by beach visitors, according to Aker, undoubtedly contributed to its eventual disintegration. Aker and associates also observed other wreckage, namely "relatively large sections of modern, wooden shipwreck on the Limantour Spit" (Aker 1965:39). Photographs taken of this wreckage show that one section of hull exposed in 1983 was visible in the early 1960s; another portion of wreckage as shown in the photographs is too deeply buried to allow identification. The location of the latter piece, however, does indicate that this piece was not exposed in 1983, inasmuch as no vessel remains were noted in its cited location. Aker also mentioned the intact remains of the vessel's aftercabin being exposed in the early 1960s. This portion of the ship's structure eventually disappeared, either breaking up or buried by encroaching beach sand.

A survey of Limantour Spit and portions of Drakes Estero behind the spit did not disclose any identified wooden remains of Pomo, but did locate portions of small machinery. Several magnetometer readings, as discussed earlier in the body of this report, indicated possible wreckage. The principal feature noted in 1982, which proved to be the diagnostic feature in identifying the wreck, was Pomo's large triple expansion steam engine, which currently protrudes from the water about 25 feet from shore. The engine, though battered and missing its outer casing, is apparently supported by buried structure. No timber remains were noted on the seabed during diving reconnaissances of the engine during the 1982 survey. The fact that the engine remains upright, however, would suggest that timbers, perhaps intact lower hull structure, are present beneath the sand and gravel overburden which forms the seabed below the engine. The nature of wooden remains exposed on the beach in 1983 also indicates that lower hull members are buried beneath the seabed. All portions seen were associated with the upper works of the ship, with no identifiable sections of the hull from below the waterline observed. At an extreme low tide on March 14, 1983, timbers were observed protruding from the seabed, and from the water, on a direct alignment with the engine some 20 to 30 feet due east. A close examination of those timbers was not possible, but their survival, as well as the nature of the beach



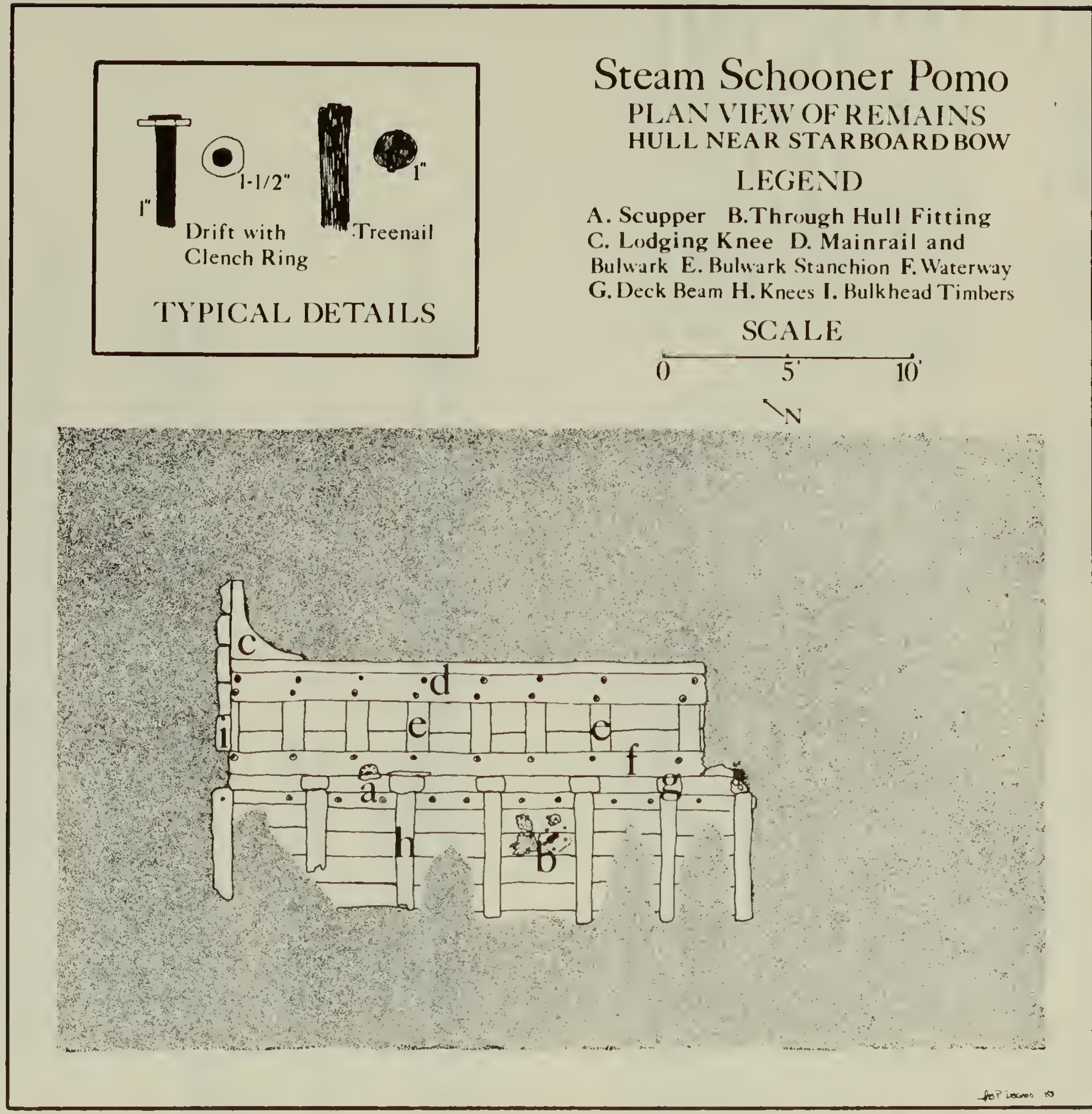
Appendix II

Figure 1. Wreckage Distribution of Pomo Exposed During Winter Storm Erosion 1982-83. (J. Delgado)

remains and the engine's upright condition, does support the hypothesis that portions of the lower hull exist buried beneath the seabed.

The portions of Pomo which were exposed on the beach in 1983 initially consisted of eight pieces. Two of these pieces had been reburied by returning beach sand by March 14, 1983, when the first professional examination of the exposed remains was made. The nature of the exposed remains is known, though. One was a portion of decking, with associated iron pipes and fittings; the other was apparently a portion of the hull with associated frames and planking. No detailed observations or measurements of these two sections were undertaken. The six remaining pieces, which were still visible in March, consisted of three sections of decking, two of which exhibited the remains of hatch coamings and carlings, which would indicate that the deck segments were located at or near the ship's single, main hatch amidships. One section of decking was particularly diagnostic with hatch coamings, lodging knees, and deck beams exposed because the decking was upside down. The third piece of decking was a square piece which appears to have been a smaller, raised deck, probably fromyPomo's distinctive high aftercabin or forecastle. The other three pieces of wreckage were associated with the upper portions of the hull, all with attached knees and portions of deck beams. One large piece, which appears to have been exposed in the early 1960s visible in photographs taken by Aker and his colleagues, exhibited a marked curve in the waterway, which would indicate that this portion of the hull was close to one end of the ship; as to which end, observations of the piece did not disclose. The second piece proved more diagnostic; though small in size, it was an intact section of upper works near the stern on the port side, with hull, knees, deck beams, waterway, bulwarks, toprail, a lodging knee, the remains of the aftercabin bulkhead, a hull fitting believed to be a bilge pump outlet, and a lead scupper (Delgado 1983a) (Figure 2). The third piece, which was located at the western end of the estero entrance near the Haypress Pond, was badly damaged by post-depositional fires, but ultimately proved to be a section of the upper hull near one end of the ship. Aker, when plotting the curve of the hull, estimated a 25-foot breadth; this and close spacing of the knees as they progressed along the piece indicated that the vessel was curving inwards. The fittings and timber were identical to those on the other Pomo wreckage and a careful check of other vessels wrecked in the area showed that the only vessel approaching the size of the vessel represented by the Haypress Pond remains was S. S. Pomo, the difference in the breadth of the fragment, 25 feet, and Pomo's 32.6 foot beam can be explained by the inward sweep of the hull at either the bow or stern.

One additional piece of wreckage was noted, but it is not certain whether it is from Pomo. Near the section of the hull from the afterportion of the port side, what appears to have been the stem, possibly the sternpost, of a vessel was seen protruding approximately 1 foot above the sand level on the beach at low tide. The timber did not appear to be Douglas Fir, as was the case with all of Pomo timbers; rather, it had the appearance of a hardwood. Nearby, at the base of a



Appendix II

Figure 2. Detail of Hull Remains of Pomo Exposed During Storms of Winter 1982-83. (J. Delgado)

sand dune, a fragment of copper ship's sheathing was found. Pomo was not copper-sheathed. The relationship, if any, between the protruding timber and the copper sheathing fragment is undetermined. It may be that a second vessel lies adjacent to the wreck of Pomo. However, in light of the cursory examination of the exposed timber, and the need for considerable additional analysis and observations, any conclusions regarding the nature of the timber and the copper sheathing would be premature.

Additional work is needed with the wooden remains of Pomo. Beach sand once again has reburied all portions of the wreckage except for the knees of the largest piece of hull on the beach and the portions of the hull section at Haypress Pond. Partial recording of only two pieces of the exposed wreckage and a brief examination of the others was all that could be accomplished in March and April of 1983. A detailed recording of each piece of wreckage, and a precise and accurate map plotting their locations is needed. However, an important result has become apparent; the extreme winter beach erosion which occurred after the severe winter storms in 1983 provided an expedient and inexpensive means of a more complete assessment of the range of wreckage associated with Pomo. Additionally, it indicated that other wooden vessel remains are preserved in Drakes Bay.

References

Aker, Raymond

1965 The Cermeno Expedition of Drakes Bay 1595: A Research Report of the Drake Navigators Guild. Drake Navigators Guild, Palo Alto.

1983 Consulting Naval Architect, Palo Alto, California. Personal Communiction.

Delgado, James P.

1983 Documentation and Identification of the Remains of the 1882 Schooner Neptune at Fort Funston, Ocean Beach, Golden Gate National Recreation Area, San Francisco. National Park Service, San Francisco.

1983a Initial Reconnaissance and Documentation of the Remains of the S.S. Pomo, Drakes Bay, Point Reyes National Seashore. March 16, 1983.

Krei, Melvin A.

1983 Preliminary Report on Discovery of Shipwreck Remains, Little River Site. Humboldt Bay Maritime Museum, McKinleyville, California.

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